

STAMNARIA AMERICANA

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## PHOTOGRAPHS AND DESCRIPTIONS OF CUP-FUNGI—XVI. STAMNARIA<sup>1</sup>

FRED J. SEAVER

(WITH PLATE 1)

The genus *Stamnaria* was founded by Fuckel on *Peziza Persoonii* which is synonymous with the previously described *Lycoperdon Equiseti* Hoffman. The species which is apparently of common occurrence in Europe has also been frequently reported from North America.

In 1902, Massee and Morgan described a new species, *Stamnaria americana*, which, according to them, was distinguished from the European form by the much larger asci and spores. In 1907 a specimen was sent to the writer from Terre Haute, Indiana, which was referred to *Stamnaria americana* Massee and Morgan. No further attention was given to the matter until the winter of 1931 when the writer received from Dr. J. H. Schaffner another large collection of the American species on *Equisetum*.

Since at this time a detailed study of the genus had been undertaken, preliminary to the monograph of the inoperculate cup-fungi, all the American specimens on *Equisetum* in our collection have been gone over carefully. So far as ascertained, all of these specimens have the characteristic large spores of *Stamnaria americana*. There is considerable variation in the size of the spores

<sup>1</sup> This paper is preliminary to a monograph of North American Cup-fungi (inoperculates), a companion volume to North American Cup-fungi (operculates), which was published by the author and issued in December, 1928.

and it may be that this is only a form of the European species. However, the difference in size of the spores and asci is so marked that it cannot be overlooked and we are therefore referring all of our American forms to that species.

It seems to the writer that this species should be included with the Cenangiaceae instead of the Bulgariaceae as has been done by some authors on account of the subgelatinous nature of the apothecia when moist. The general habits of the plants and spore characters all indicate a relationship with that family.

Since very little has been published on this species in America, this opportunity is taken to publish description, photograph and drawings based on the collection sent by Dr. J. H. Schaffner from Ohio. Dr. Schaffner states that the fungus is very destructive to the host plants which occur in a large patch consisting of several acres. He also states: "The cavities of this horsetail are more or less filled with free water all winter long, and the fungus seems to thrive, especially in the fall of the year."

STAMNARIA Fuckel, Symb. Myc. 309. 1869

Apothecia erumpent-superficial, occurring singly or more often in cespitose clusters, more or less gelatinous, horny when dry, sessile or short-stipitate; asci clavate, usually 8-spored; spores simple ellipsoid, hyaline; paraphyses filiform, slightly enlarged above.

Type species, *Peziza Persoonii* Moug.

STAMNARIA AMERICANA Massee & Morgan, Jour. Myc. 8: 183.  
1902

*Gloeosporium Equiseti* Ellis & Ev. Jour. Myc. 4: 52. 1888.

Apothecia erumpent in clusters of 3-4 each or in rows 6-7 mm. long, the individual apothecia sessile or subsessile, at first rounded, gradually expanding and becoming turbinate, reaching a diameter of .5-.7 mm., pale-orange; hymenium plane or slightly concave, similar in color to the outside of the apothecium, whitish pruinose from the ends of the protruding asci and paraphyses; asci clavate, 8-spored, reaching a length of 150-200  $\mu$  and a diameter of 16  $\mu$ ; spores 1-seriate or partially 2-seriate above, ellipsoid, straight or curved, usually with one or two large oil-drops surrounded with a granular contents, hyaline,  $7-9 \times 24-32 \mu$ ; paraphyses filiform, rather strongly enlarged above, pale-orange in mass.



On species of *Equisetum*: *E. arvense*, *E. hyemale*, *E. laevigatum*, and *E. robustum*.

TYPE LOCALITY: Preston, Ohio.

DISTRIBUTION: New York and New Jersey to Indiana and (Oregon?).

EXSICCATI: N. Am. Fungi 1274 (as *Peziza Persoonii*) 2275, 2449 (conidial stage); Fungi Columb. 333 (as *Stamnaria Equiseti*); 1349 (conidial stage); Kellerm. Ohio Fungi 18.

Since this article was sent to the printer an additional collection on the conidial stage of this fungus, *Gloeosporium Equiseti*, was sent to the writer by Dr. J. H. Schaffner from Yosemite Valley, California.

THE NEW YORK BOTANICAL GARDEN,  
BRONX, NEW YORK CITY

## A POWDERY MILDEW ON COTTON FROM PERU

E. V. ABBOTT

(WITH 1 TEXT FIGURE)

Powdery mildew is one of the most common diseases of cotton in Peru, occurring in all of the cotton-growing valleys of the coastal region where cotton is a major crop. In spite of its wide distribution and the heavy infections which frequently occur, however, it is of minor economic importance.

The disease is characterized by the appearance of scattered, circular patches of mycelium, first on the lower and later on the upper surfaces of the leaves. The patches are usually numerous and enlarge until they coalesce to cover the entire leaf surface. When a large part of the leaf is covered by the mildew, it curls slightly, frequently turns yellowish, and may finally fall. Late in the season the heavy growth of the fungus on the leaves sometimes gives the fields the appearance of being covered with a light fall of snow, giving rise to the local common name for the disease of "manta blanca" or white mantle. Although such heavy infections may cause partial defoliation, little damage results because of the advanced stage of maturity of the plants.

Field observations have shown that several North American varieties of cotton are more susceptible to the disease than either the native Peruvian cotton (*Gossypium peruvianum*) or the hybrid Tanguis, which is the principal commercial variety of the country. The heaviest infections have been noted on Acala. Pima, Delfos, Express and Super Seven are also susceptible. Because of the minor economic importance of the disease no control measures are suggested.

The causal fungus has been identified as *Erysiphe Malachrae* Seaver after comparison of Peruvian collections with type material collected by Dr. N. L. Britton and F. S. Earle March 11, 1922 (Expl. of Porto Rico 6488), kindly furnished by Dr. Seaver. Both the imperfect and perfect stages usually occur in the field.

The conidial stage is limited almost entirely to the lower leaf surfaces while the *Erysiphe* stage is most abundant on the upper surfaces. In Piura, the northernmost cotton-growing section of Peru, where the climate is much hotter and drier than in the valleys to the south and where Pima is grown almost exclusively, the writer has not observed the *Erysiphe* stage. In the other valleys both stages have always been found together, on Pima as well as on other varieties, indicating that the absence of the perfect stage from Piura is the result of climatic rather than varietal influences.

The conidial stage is believed to be *Ozulariopsis Gossypii* Wake-

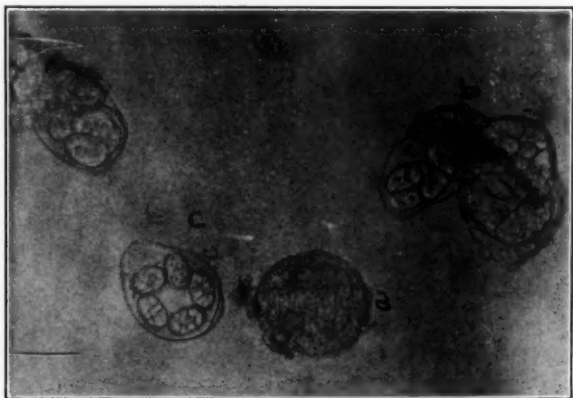


FIG. 1. Photomicrograph of *Erysiphe Malachrae*, a, perithecium showing rudimentary appendages; b, perithecium discharging asci; c, ascus with ascospores. ( $\times 350$ .)

field. While direct comparison with material of the West Indian mildew has not been made, Wakefield's description of the disease and figure of the fungus agree so closely with the writer's notes on the Peruvian disease that it appears very probable they are the same. The conidia of the Peruvian fungus are elongate elliptical, muticate,  $35$  to  $60\ \mu$  by  $14$  to  $30\ \mu$ , with finely granular contents.

It is interesting to note that this is the only *Erysiphe* collected in Peru by the writer, although the conidial stages of several powdery mildews were collected on 36 species of cultivated and 11 species of uncultivated plants. It is a rare instance of the occurrence of *Erysiphe* in the tropics.

## LITERATURE CITED

- Seaver, Fred J. Sci. Surv. Porto Rico and Virgin Islands 8: 27. 1926.  
Wakefield, E. M. On two species of *Oculariopsis* from the West Indies.  
Kew Bull. Misc. Information 1920, p. 235-238.

DEPARTMENT OF PLANT PATHOLOGY,  
ESTACION EXPERIMENTAL AGRICOLA,  
LIMA, PERU

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EDITOR'S NOTE

It is interesting to note that this powdery mildew which was first observed on a malvaceous weed in Porto Rico should later be found on cultivated cotton in such a remote region as Peru. Although the conidial stage of several species of powdery mildew is quite abundant in Porto Rico on a number of hosts, so far as the writer is aware, this is the first time that any have been found there in perfect fruit. Neither has any subsequent collection been obtained although a special search has recently been made for it by C. E. Chardon, who collaborated with the writer in the survey of the fungi of Porto Rico.

## CROSSING HERMAPHRODITIC RACES OF NEUROSPORA

B. O. DODGE

(WITH 3 TEXT FIGURES)

In the account "Inheritance of the albinistic non-conidial characters in interspecific hybrids in *Neurospora*,"<sup>1</sup> there were described a number of plate cultures in which were grown two different hermaphroditic races. Some combinations resulted in the production of ascocarps along the meeting line in addition to those formed about the points of inoculation. The irregularities in spore numbers in asci from the perithecia along the line were such as to suggest in some cases that the two races had hybridized. Individual asci had not been analyzed thoroughly to prove this, however. Later many more combinations were made and cultures were obtained from all of the spores from individual asci. The results prove that in many combinations the line ascocarps were purely the product of the one or the other race through self-fertilization. In other words, two hermaphroditic races of *Neurospora* each of which is more or less self sterile may become more self fertile when grown opposite each other. It has been found for other ascomycetes also that fruit bodies often develop where two mycelia meet because of nutritive conditions and without involving cross fertilization.

Crossing *Neurospora sitophila* and *N. tetrasperma*, gives larger perithecia than either parent, but this should not mislead one as to the nature of the exceptionally large perithecia formed where two hermaphroditic races such as "Tet" and "4A<sub>5</sub>" meet. Straight *N. tetrasperma* which is conidial and hermaphroditic, and 1A<sub>7</sub> which is non-conidial and hermaphroditic,<sup>1</sup> grown opposite each other, gave four kinds of ascocarps. Each race produced its own fruit bodies by self-fertilization. Over on the *N. tetrasperma* side of the line were scattered here and there exceptionally large perithecia. A few of their asci were analyzed

<sup>1</sup> Mycologia 23: 1-50. 1931.

Each had four nuclei carrying the +C factors for conidia and the other four were non-conidial. Other ascocarps of intermediate size taken from the central line were also proved to be hybrids. Most of the pairs of hermaphroditic races grown together so far, however, did not hybridize where their mycelia met.

On the other hand when a unisexual race such as  $S_1$ ,  $S_6$ , 22 or 34 is grown opposite hermaphroditic races like 3C or 1A, hybrids are usually produced along the meeting line as was noted in the paper cited above. The diagram (Fig. 1) shows how this was

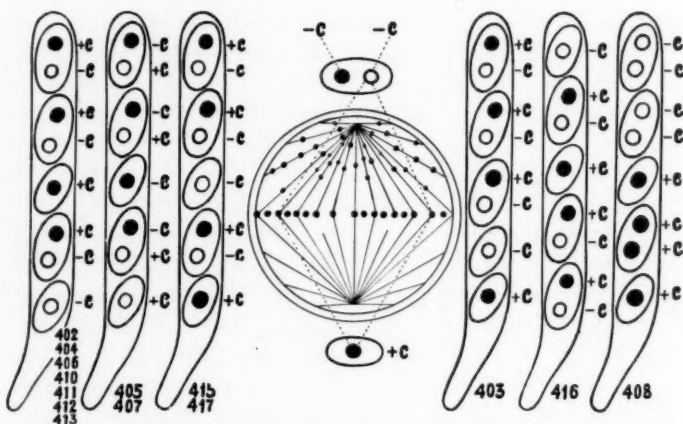


FIG. 1. Results of crossing race 3C, which is hermaphroditic and non-conidial ( $-c$ ), and  $S_1$  one of the unisexual components of *Neurospora tetrasperma*; it is of sex B and conidial ( $+C$ ). Only 5-spored asci are diagrammed. Sex A nuclei are shown as white circles, sex B as black circles. Most of the asci from this cross are 4-spored. See text for further explanation.

proved. These races, when mated, produce mostly 4-spored asci, but there are always a few 5-spored asci in each perithegium. The latter are selected for study because once the nature of the two little spores is determined it is not always necessary to culture the large spores. Race 3C is non-conidial and hermaphroditic. Race  $S_1$  is conidial and of sex B. It is clear that ascospores from 3C alone through self fertilization can not produce mycelia which bear conidia. Any ascus in which it is proved by cultures that

four of the original eight nuclei were conidial and the other four non-conidial must have been a hybrid between 3C and  $S_1$ . Cross fertilization is here more potent than selfing.

It is interesting to note that in thirteen out of the fourteen asci diagrammed here, one of the small spores lies at the lower end of the ascus. The fact that a large spore usually lies between the two little spores is easily accounted for by the irregular orientation of the spindles of the third nuclear divisions. This point will be explained by Dr. Carl C. Lindegren through whose courtesy the diagram slightly modified for the present purposes is published here also. At the right the diagram shows that all of the spores will be unisexual provided the sex factors segregate in the second division and as the spindles elongate the two nuclei of the same sex move in the same direction. This peculiarity has been discussed in previous papers, and Kniep<sup>2</sup> has also covered the same point in his diagram "Abb 5."

If we replace  $S_1$  with  $S_6$ , the other unisexual component of *N. tetrasperma*, then two lines of ascocarps are formed. The first are hybrids through crossing 3C and  $S_6$ , the others formed several weeks later are purely 3C through selfing. This illustrates again how a change in nutritive conditions by the presence of another mycelium may increase the self fertility of the hermaphroditic race.

Brief reference to the work of the Moreaus,<sup>3</sup> on the cytology of species of *Neurospora* was made in the paper cited. The questions at issue are rather important as bearing on the old controversy of nuclear behavior in the Ascomycetes. It may not be out of place to show by diagram how the evidence which these authors have furnished really proves beyond question that there must be two nuclear fusions in the life cycle of species of *Neurospora*. The Moreaus state that the cells of the ascogonium of *Neurospora* are at first multinucleate but later on show only a single nucleus each. This condition is pictured in the lower part of the diagram (Fig. 2). Ascogenous hyphae grow out from a uninucleate ascogenous cell. Each cell of the ascogenous hyphae has a single nucleus so that the crozier arises from a stalk cell with only one nucleus.

<sup>2</sup> Kniep, H. Vererbungserscheinungen bei Pilzen. *Bibliographia Genetica* 5: 371-476.

<sup>3</sup> Moreau, M. & Mme. Fernand. Le développement du périthèce chez quelques Ascomycètes. *Rev. Gén. Bot.* 42: 65-98. 1930.

Conjugate division in the crosier having occurred, the two non-sister nuclei fuse. According to their story the ascus nucleus Z must be merely diploid.

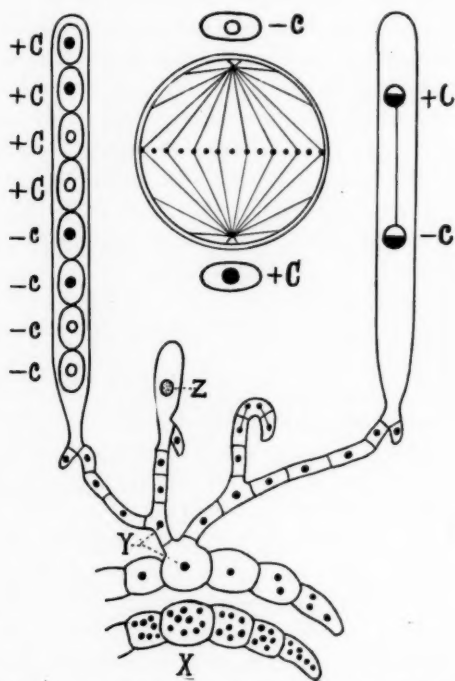


FIG. 2. Diagram to show how the primary nucleus Z of an ascus must be tetraploid if the cytological picture presented by the Moreaus<sup>3</sup> is correct. The lower part of the diagram from X to Z is adapted from their figures. The upper part shows what happens when a conidial race of one sex is mated with a non-conidial race of the opposite sex. Since the nucleus Z must contain the factors +C and -C the nuclei Y must be diploid through some previous nuclear fusion.

Above in the figure is diagrammed a plate culture in which two strains of *Neurospora sitophila* of opposite sex are opposed. The mycelium of one race bears conidia (+C), that of the opposite sex is non-conidial (-c). When one isolates the eight spores from an ascus he finds that four of them carry the +C factors and the other four are non-conidial (-c). In some way the



nucleus Z must have received the inheritance carried by each of the two original ascospores with which the culture was inoculated. Since the two nuclei that fused to make Z were derived from a single stalk cell nucleus that goes back to Y for its inheritance, then all of the nuclei of the ascogenous hyphae and the single nucleus of the ascogenous cell must be diploid. If the cytological picture is as claimed by the Moreaus, then there must have been somewhere a nuclear fusion of haploid nuclei, followed by a fusion of diploid nuclei in the ascus as claimed by Harper.

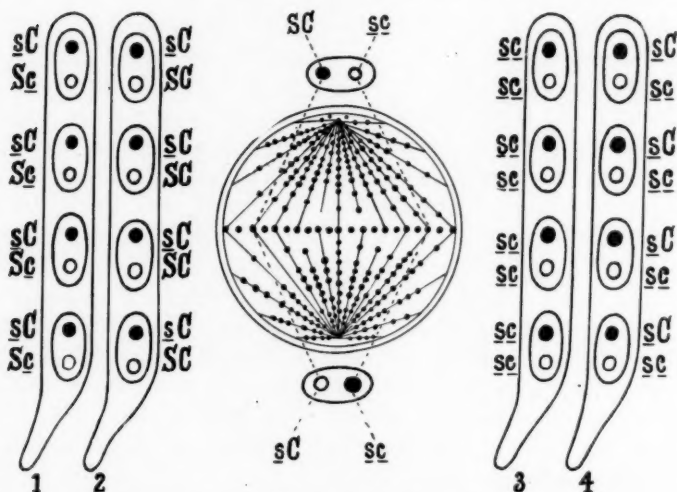
Suppose now some student of the Claussen school should present another cytological paper on *Neurospora* and claim that the several nuclei in the ascogenous cell do not all disappear but one, and claim, instead, that each cell has two nuclei of opposite sex as Claussen stated for *Pyronema*. Would the genetic evidence for a double nuclear fusion then be discredited? No one knows just what happens at the origin of a perithecium. Assume first that only a single pair of nuclei of opposite sex are involved. The diagram shown in figure 3 is constructed to bring out what happens if two hermaphroditic races are grown opposite each other in a culture. As before, the nuclei of opposite sex are indicated in black and white, and the conidial factors by C and c. A third character, the presence or absence of sclerotia, is indicated by S and s respectively. Any other clear cut character may be substituted if necessary.

If only the two nuclei SC and sc from the spore above in the diagram are involved (self fertilization) then all of the asci in that perithecium must be like ascus no. 1. If a hybrid perithecium from the cross  $SC \times sc$  results, then the asci should be like no. 2. In the perithecium  $sc \times sc$  the asci must all be homozygous and like no. 3. With self fertilization involving sC and sc from the spore below in the diagram the asci are like no. 4. Barring minor changes in the ascus pictures due to peculiarities of segregations and distribution of the nuclei before spore formation in each case, all of the asci in any particular perithecium must be alike.

Many different pairs of nuclei Claussen<sup>4</sup> says are involved in the formation of the ascocarp of *Pyronema*. Suppose this were found to be true for these hermaphroditic races of *Neurospora*.

<sup>4</sup> Claussen, P. Zur Entwicklungsgeschichte der Ascomyceten *Pyronema confluens*. Zeits. Bot. 4: 1-64. 1913.

It is clear without further explanation that then we should find all four kinds of asci within the same perithecium. But suppose that the Harper<sup>5</sup> theory of a double nuclear fusion is also operating. It is evident that one might find occasionally a perithecium in which some one ascus would contain all of the inheritance carried by all four nuclei, SC and sc of one sex and sC and sc of the opposite sex. This phase of the work will be studied as time



### Hybridizing two hermaphroditic races.

FIG. 3. Matings of two hermaphroditic races of *Neurospora*. See text for further explanation.

permits. In the meantime we must expect several contradictory stories of nuclear behavior, based wholly on cytological studies.

If perithecia mature because of the stimulus derived from diffusible hormones rather than from sexual reproduction, or a union of nuclei of opposite sex due to anastomosing hyphae, as recently claimed by Moreau and Moruzi<sup>6</sup> we still would have to account

<sup>5</sup> Harper, R. A. Sexual reproduction in *Pyronema confluens* and the morphology of the ascocarp. *Ann. Bot.* 14: 321-400. 1900.

<sup>6</sup> Recherches experimentales sur la formation des périthèces chez les "*Neurospora*." *Compt. Rend. Acad. Sci. Paris.* 192: 1475-1478. June 8, 1931.

for the mendelian inheritance of morphological characters exhibited in our breeding experiments. Although the gene continues to shrink more and more in size under the scrutiny of modern geneticists, it would be rather revolutionary to think of hormones which can exist outside of the organism and which can wander several centimeters away from their parent chromosome as being wholly responsible for mendelian phenomena.

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#### NOTE

The results of experiments similar to those described by Moreau and Moruzi, carried out by the writer since the above paper was sent to press, do not confirm their claims. Some fifty U-tube cultures in which strains of opposite sex of *Neurospora sitophila* were grown in opposite arms of the tubes as described by these authors have been observed for periods up to four months in length. In no case have perithecia been formed at the surface of the agar in either arm of a tube. Perithecia are matured, however, in every culture just as soon as, due to the drying out of the agar, air pockets move down the arms of the tube so that the two mycelia can come together in the presence of air. Only under such conditions are perithecia formed in these tubes. A more detailed account of these experiments is being published elsewhere.

# TAXONOMIC STUDIES IN THE FAMILY PYTHIACEAE

## II. PYTHIUM<sup>1, 2</sup>

C. P. SIDERIS

(WITH 21 TEXT FIGURES)

### INTRODUCTION

Butler's (4) studies comprised in his paper "An Account of the Genus *Pythium* and Some Chytridiaceae" constitute the best and most exhaustive document we have on the morphology and taxonomic position of this group of organisms. The relationship of the genus *Pythium* to *Nematosporangium* on the one hand, and to *Phytophthora* on the other, has been discussed in a previous paper (11). The discussion contained herewith deals with (1) certain improvements on the classification of members of this genus, (2) the description of new species, and (3) the relationship existing between different species.

### THE GENUS PYTHIUM

The genus *Pythium* as presented in the following pages comprises the group of organisms heretofore belonging, according to Fischer's (5) classification, to the subgenus *Sphaerosporangium*. Besides the organisms originally placed by Fischer in the subgenus *Sphaerosporangium*, there are others that had been described later and either placed by Butler or others likewise in the same subgenus. The total list is a rather long one.

With the adoption of the genus *Nematosporangium*, the subgenus *Sphaerosporangium* is automatically dropped as it is the only subgenus left in the genus *Pythium*. The further grouping of

<sup>1</sup> The species of *Pythium* included in these studies are only those isolated by the writer and Mr. G. E. Paxton from diseased pineapple roots and a few others sent by Dr. W. D. Valleau.

<sup>2</sup> Published with the approval of the Director as Technical Paper No. 20 of the Experiment Station of the Association of Hawaiian Pineapple Canners, University of Hawaii.

organisms with many similarities and dissimilarities in this genus is taken care of by the introduction of sections and subsections according to the importance of the characters under consideration.

Fischer established for this purpose the sections *Orthosporangium* and *Metasporangium*, the former including all those organisms reproducing asexually by means of zoöspores and the latter those by means of conidia. Other characters such as the plerotic as opposed to the aplerotic and the smooth as opposed to the spiny oöspores have been given a secondary position in the taxonomy of species. The shape of the antheridia appears to have escaped the attention of Fischer and the other investigators.

#### REPRODUCTION

The various members of *Pythium* reproduce in five distinct ways: (1) by hyphae, (2) by gemmae, (3) by conidia, (4) by zoöspores, and (5) by oöspores.

The various methods may be grouped in three categories as follows:

1. Somatic reproduction, including (1) and (2).
2. Asexual reproduction, including (3) and (4).
3. Sexual reproduction, including (5).

Some organisms reproduce by one or two methods and others by more than two: *P. polycladon*, for example, reproduces by four and possibly, by all five methods.

#### SOMATIC REPRODUCTIVE ORGANS

##### MYCELIUM

The mycelium of species of the genus *Pythium* varies in many of its features. It may be aerial or submerged, this being conditioned by the chemical composition of the substratum, sugars or starches having been observed to favor aerial development. Individual hyphae may or may not be septate depending mostly on their age and to a certain extent on the nutrient content of the substratum. Hyphae differ by their thickness, branching, consistency of their protoplasmic contents (that is, whether coarse granular, emulsoïd-opalescent or emulsoïd-hyaline), regularity or

irregularity, production of allantoid and subspherical bodies, etc. Colonies are represented by various morphological types in the different species such as the plain-radiate (FIG. 1, *a*), pulvinate-radiate (FIG. 1, *b*) and rosette (FIG. 2, *c*). According to Butler (4) the size and thickness of the hyphae of *Pythium* do not approach those of either the Saprolegniaceae or the Peronosporaceae. The allantoid or subspherical bodies common on the hyphae of such species as *P. diameson*, *P. allantocladon*, *P. euthyhyphon* and *P. ascophallon* represent reservoirs of protoplasmic material and serve for the vegetative propagation of these organisms.

#### GEMMAE

These structures, represented by extrusions of protoplasm through diametrical breaks produced near the tips of hyphae, have been observed only in *P. polycladon* (FIG. 5, *h*). They are not like those formed in *P. rostratum* as illustrated by Butler. They are produced only under slightly adverse conditions, that is, when the organism is grown in culture media not suitable for the production of conidia or zoösporangia. They germinate giving rise to many hyphae simultaneously.

#### ASEXUAL REPRODUCTIVE ORGANS

The organs of asexual reproduction are as follows: (1) the prosporangium or sporangium, (2) the zoösporangium or vesicle, and (3) the conidium.

The prosporangium is the reservoir of protoplasmic matter destined for the production of zoöspores. It varies appreciably in form and size in the different species, being spherical, subspherical, pyriform or lemon-shaped and measuring between 15 and 50  $\mu$  in diameter. It may be terminal or intercalary; in the former case, it is separated from the supporting hypha by a single septum and in the latter case by two septa, one on either side. The production of prosporangia may be rapid or slow according to the behavior of the species producing them.

The germination of a "prosporangium" may give rise either to a vegetative hypha or to a vesicle (zoösporangium) into which are discharged the protoplasmic contents which gradually become

differentiated into zoöspores. The prosperangium in the first case is known as a conidium.

A characteristic feature of a prosperangium is its exit tube. This collar forms at the time of maturity, when the prosperangium gives rise to the zoösporangium, the former discharging its protoplasmic contents into the latter organ. The emission collar varies in length in the different species and may be produced terminally or laterally.

The zoösporangium is the organ wherein the differentiation of the protoplasmic matter, discharged by the prosperangium, takes place. The protoplasm after entering the vesicle undergoes very rapid changes which in 10 to 15 minutes give rise to many reniform biciliate zoöspores. The life of the zoösporangium *per se*, or vesicle, is extremely short. Its wall is a continuation of the ectoplast or inner membrane of the prosperangium. It lasts as long as is required for the differentiation and development of zoöspores, by whose movements it is disrupted. The zoösporangium varies in size in the different species measuring between  $15\ \mu$  and  $50\ \mu$  or more in diameter.

The zoöspores are reniform and biciliate, the cilia arising from the hilum in all the different species studies. They measure between  $8$  and  $12\ \mu$  in diameter at rest. They germinate usually with one germ tube, though occasionally two or more are formed. Their period of motility may last from 5 to 60 minutes and possibly longer depending on environmental conditions.

The conidium is morphologically identical with the prosperangium, except for the type of germination. The conidia of all species of *Pythium* studied are pseudoconidia, that is, they never fall off their supporting hyphae but germinate *in situ*. They may occur in great or moderate numbers or not at all.

#### SEXUAL REPRODUCTIVE ORGANS

The organs of sexual reproduction, namely, the oogonium and antheridium, vary morphologically in the different species.

The antheridium may vary in shape, size, and position in its relation to the oogonium. The shape of most antheridia is clavate, some are more or less cylindrical and others ascomorphic (bag-like). Their length as well as diameter may vary in different

species. Their position in respect to the oögonium may be hypogynous or epigynous. They may be produced from the oögonial hypha or from a different one and occasionally two or three may be borne on the same hypha. The length of the supporting hypha of antheridia, especially of those produced on the oögonial hypha, may be very short or appreciably long.

The oögonia of *Pythium* are spherical to subspherical and all are smooth with the exception of those of *P. megalacanthum* and *P. Artotrogus* which are spiny. They vary considerably in size, measuring between 10 and 70  $\mu$  in diameter. They may be terminal, intercalary (mostly), or lateral. In culture media they are intra- or extra-matrical and in the tissues of hosts intra- or extra-cellular. Their development, maturity and fertilization may be completed in two to ten days in the majority of species. The protoplasmic contents of unfertilized oögonia have a granular appearance and are distributed uniformly throughout the entire organ. Those of fertilized oögonia, however, lose their original colloidal state and concentrate as much as possible towards one side or the center.

The oöspores of *Pythium* are mostly spherical. Those of certain species fill the oögonium (plerotic) and those of others do not fill it (aplerotic). They may be either smooth or spiny. The production of spines and other such appendages seems to be associated with shrinking and distension phenomena in the oögonial membrane of aplerotic oöspores (see FIG. 18). The oöspores, measuring between 8 and 60  $\mu$  in diameter, may contain one large globule of fat or occasionally two or more smaller ones. The thickness of their wall varies between 0.5 and 2.0  $\mu$ . They may germinate in a few days, weeks or months, giving rise either to a vegetative hypha or to a zoösporangium. They are produced in culture media intra- and extra-matrically and in the tissues of hosts intra- and extra-cellularly.

#### CERTAIN TAXONOMIC CONSIDERATIONS IN PYTHIUM

When Pringsheim (9) assigned the generic name *Pythium* to the group of organisms under consideration it was doubtless on account of the morphology of either their emptied prosperangium or the type of injury caused to the roots of plant seedlings. The



emptied prosoporangia of *Pythium* (those that have produced zoösporangia) resemble in shape a jug, the equivalent Greek word of which is *pithos* and the diminutive *pithion*. The type of root injury caused to plant seedlings by various members of the genus *Pythium* is a rot, the equivalent Greek word of which is *pythos*, from the verb to cause rot. Therefore, only those members of pythiaceous organisms possessing a pithioid prosoporangium should be assigned the generic name of *Pythium*. By applying this definition those species belonging to the two closely related genera, namely, *Nematosporangium* and *Phytophthora* are automatically excluded. Species of *Nematosporangium* never produce a pithioid prosoporangium, and species of *Phytophthora* never produce a neck or exit tube on their prosoporangia to be classed as pithioid.

The production of plasmatoögoes in the tissues of hosts is a constant feature associated with all the different species of *Nematosporangium*. Similar structures have never been observed to be produced intracellularly by either *Pythium* or *Phytophthora*.

The relatively rapid production of oöspores in the tissues of hosts is a feature more or less constant with all or most species of *Nematosporangium* and *Pythium*, but not with *Phytophthora*.

*Pythium* is divided according to the type of development of its prosoporangia. The "prosopangia" of *Pythium* as well as those of *Phytophthora*, may act either as true conidia or as zoösporangia. Fischer (5) created the section *Orthosporangium* to take care of those organisms reproducing by means of zoöspores, and *Metasporangium*, for those reproducing by means of conidia. According to this classification many closely related organisms are placed in different sections. For example, certain varieties of *P. Debaryanum* have been observed to reproduce by means of both zoöspores and conidia and others by means of conidia alone. Certain varieties of *P. irregulare* and *P. megalacanthum* behave in the same way. It is unreasonable to classify in two distinct sections varieties of the same species.

It appears that changes in the asexual reproduction which favor the development of either zoöspores or conidia are not of fundamental importance, as they are impressed mostly by environmental conditions and may become fixed in certain varieties or remain in a transitory state. Therefore, the subdivision of *Pythium* into the

sections *Orthosporangium* and *Metasporangium* is neither of fundamental importance nor of great reliability for the grouping of organisms. Separation of species on this basis, however, is justified as will be indicated later.

The writer has observed that morphological differences in the sexual organs and especially the antheridia and oöspores are of greater fundamental importance and of greater stability than those in the asexually reproducing organs. For example, the ascomorphic as opposed to the clavate type of antheridium constitutes a very stable and reliable character for the differentiation of species and for their classification as elementary or advanced forms. The ascomorphic type is associated with more elementary forms of organisms than the clavate type. The writer proposes, therefore, that *Pythium* be subdivided into the subgenera *Platyphalla* and *Stenophalla*, the former including those species with ascomorphic antheridia and the latter those with clavate antheridia. The oöspores of the different species of *Pythium* are either of the plerotic or the aplerotic type, their morphology in this respect being of fundamental importance. It is a constant feature, not altered or modified in any way by environmental conditions. The sections *Plerospora* and *Aplerospora* are proposed, the former to include those species with plerotic and the latter, those with aplerotic oöspores. There are also a number of species whose sexual reproduction is unknown. These are placed on the basis of certain morphological characters next to the species of the sections whose sexual reproduction is very rare.

Besides the main subdivisions, there are subdivisions of a secondary and tertiary type in connection with the proper classification of these organisms. The organisms of *Aplerospora* may have both smooth and spiny oöspores. A subdivision between these morphologically different subgroups is essential. The creation of the subsections *Leiospora*, *Polymorphospora* and *Acanthospora*, the first including those with smooth oöspores, the second those with both smooth and spiny, and the third, those with only spiny oöspores, will segregate three groups of organisms the oöspores of which, although all aplerotic, are different in appearance.

To return to the taxonomic importance of the development of "prosporangia" into conidia or into zoösporangia, these characters, as mentioned before, are variable and unreliable to use in a major subdivision. They can be used, however, with a fair degree of safety as a character of a minor subdivision. Organisms reproducing by means of both zoöspores and conidia, and by conidia alone, may be designated as orthosporic and metasporic, respectively.

The order followed for the placement of the various species in an ascending or descending scale is that shown by the morphological simplicity or complexity of the oöspores. Those species whose oöspores are aplerotic have been considered the simplest forms. These are followed by those species with plerotic oöspores. Such an order seems to be rational as well as simple and although it may not follow the order of phylogenetic relationship among the different species, nevertheless it is convenient, for which reason it is presented here.

The rosette type of colony as opposed to the pulvinate and other similar types is a very distinctive feature of different species of *Pythium*.

The writer's definition of *Pythium* "that only organisms with pithoid prosporangia should be placed in the genus *Pythium*" although perfect in so far as it goes is too general and, therefore, requires some modification to make it more elastic in the case of those organisms whose prosporangial or rather zoösporangial stage has never been observed. There are quite a number of other characters common to all species of *Pythium* besides the prosporangial or zoösporangial stage, such as morphology of the hyphae. It is possible that in cases of this type where many transitional forms are likely to be met with uncertainties will always exist. *P. acanthophoron* described in this paper as new presents such a case. This organism produces oöspores profusely but has never been observed to produce prosporangia or zoösporangia. Its mycelium, however, has the usual *Pythium* type of growth but in addition it has extremely short branches appearing like protrusions that bring it close to the dendroid type of mycelium of *Phytophthora*. There is no other way of classifying such an organism except by taking into consideration the sum total of its morphological characters.

## NUTRITIONAL REQUIREMENTS OF PYTHIUM

*Pythium*, like *Nematosporangium*, grows best on culture media prepared from vegetable tissues. Although there is quite an appreciable variation in the behavior of the different species, most of them reproduce readily in a relatively wide variety of culture media. There are some that reproduce extremely rarely, either sexually or asexually, both in culture media and in tissues of hosts.

There is a natural tendency for the various species to reproduce mostly in one way, that is, either asexually or sexually. Those species that reproduce readily by both methods are very few. It is difficult if not impossible, to alter such behavior in some of these organisms with the use of culture media. Culture media for *Pythium* cultures should be considered always from the point of view of their nutritional value. They should be rich in amino acids, proteins, sugars, fats and all such constituents essential for the production of protoplasmic matter.

## CULTURE MEDIA

The media best suited for the growth of species of *Nematosporangium* were found also suitable for the different species of *Pythium*. *Carica Papaya* juice, and the seeds of *Cucumis Citrullus*, *C. Melo* and *Cannabis sativa* or such combinations as *Cucumis Melo* seeds, *Cannabis sativa* seeds and dextrose, described in my previous paper (11), were found to give the best results. Culture media prepared through the activation of bacterial ferments or vitiated in some way by microbiological waste products are not as suitable for the successful growth and reproduction of pythiaceous organisms as those referred to above.

## TECHNIQUE

The technique described under *Nematosporangium* (11) was, likewise, followed in these studies. The organisms were grown mostly on *Carica Papaya* agar, each one in five separate Petri dish cultures and its growth, sporulation and other types of behavior studied daily.

KEY TO THE SPECIES OF PYTHIUM<sup>2</sup>

- A. Antheridia broad, ascomorphic, undergoing slight morphological changes before and after fertilization: PLATYPHALLA.
- B. Oöspores aplerotic; section: *Aplerospora*.
- C. Oöspores smooth; subsection: *Leiospora*.
- D. Asexual reproduction metaspore; conidia very rare and small, oöspores produced in culture media and tissues of hosts.
- E. Hyphae mostly regular, laterals with many allantoid bodies; colony slightly rosette on solid culture media; aerial mycelium either lacking or poorly developed; oöspores in suitable culture media: *P. allantocladen* (1)
- EE. Hyphae mostly regular, laterals very rarely with allantoid bodies; colony strongly rosette on solid culture media; aerial mycelium strongly developed; gemmae occasionally present; oöspores many in suitable culture media: *P. ascophallon* (2)
- DD. Asexual reproduction orthosporic and metaspore; prosperangia spherical to subspherical, terminal and intercalary, exit tube lateral, conidia same size as prosperangia.
- E. Oöspores produced readily in suitable culture media and tissues of hosts; produced mostly at the expense of asexual organs and vice versa; hyphae mostly regular, laterals without allantoid bodies; colony mostly rosette on solid culture media; aerial mycelium moderately to well developed: *P. complectens* B. (3)
- EE. Oöspores produced occasionally in the tissues of hosts, never observed in culture media.

<sup>2</sup> This key is more descriptive than necessary for the purpose of pointing out most of the outstanding morphological and cultural characters of each organism.

- F. Colony when young, strongly rosette, when old covered with a thick layer of aerial mycelium; gemmae present; hyphae regular, laterals irregular, branching dichotomously, in zigzag formations, without allantoid bodies; exit tube of prosperangium terminal: *P. polycladon* (4)
- FF. Colony when young, strongly rosette, aerial mycelium either lacking or poorly developed; oöspores and antheridia not observed; germination tube of prosperangium lateral; gemmae not present: *P. chamaihyphon* (5)
- FFF. Colony when young radiate, aerial mycelium mostly lacking; exit tube of prosperangium terminal; oöspores observed only in the tissues of hosts; hyphae very regular, straight, laterals of a smaller diameter with few large allantoid bodies: *P. euthyhyphon* (6)
- EEE. Oöspores never observed in culture media or tissues of hosts. Colony rosette, slow growing; aerial mycelium well developed in old cultures; hyphae regular, branching laterally: *P. intermedium* (7)
- CC. Oöspores spiny; subsection: *Acanthospora*.
- D. Asexual reproduction unknown; hyphae irregular, dendroid, aerial mycelium poorly developed; antheridia epigynous; oöspores mostly terminal, small with short spines: *P. acanthophoron* (8)
- DD. Asexual reproduction mostly metasporic and rarely orthosporic; prosperangia mostly intercalary developing into conidia;

hyphae irregular; colony faintly developed with small superficial whitish specks; antheridia epigynous; oöspores large, terminal, with long spines:

*P. megalacanthum* (9)

BB. Oöspores plerotic; section: *Plerospora*.

(No species have been found belonging in this section.)

AA. Antheridia more or less narrow, clavate, not undergoing appreciable morphological changes before or after fertilization:

STENOPHALLA.

B. Oöspores aplerotic; section: *Aplerospora*.

C. Oöspores smooth; subsection: *Leiospora*.

D. Asexual reproduction orthosporic and metaspore; prosperangia spherical to subspherical, small, orthosporic in certain varieties and metaspore in others, exit tube lateral, conidia same as prosperangia; oöspores produced readily and numerous in culture media and tissues of hosts; antheridia mostly one in relation to a single oögonium; hyphae regular, laterals without allantoid bodies; colony pulvinate to arachnoid; aerial mycelium well developed:

*P. Debaryanum* (10)

DD. Asexual reproduction never observed; oöspores extremely few in culture media, terminal, intercalary and catenulate; antheridia 1 to 2 in relation to a single oögonium; hyphae regular, laterals with a prominent constriction at base; colony radiate; aerial mycelium poorly developed:

*P. araiosporon* (11)

DDD. Asexual reproduction metaspore; conidia mostly large spherical to subspherical; oöspores rare produced only in the tissues of hosts and old cultures; antheridia mostly one in relation to a single oögonium; hyphae relatively regular, laterals terminating in irregular bodies; colony arachnoid; aerial mycelium well developed:

*P. splendens* (12)

*E.* Conidia teratomorphic and also spherical to subspherical; oöspores produced in the tissues of hosts; antheridia not observed; hyphae broad; colony arachnoid to pulvinate and slightly zonate; aerial mycelium well developed: *P. teratosporon* (13)

*CC.* Oöspores smooth or with one to many spines; subsection: *Polymorphospora.*

*D.* Asexual reproduction mostly metasporic and occasionally orthosporic; prosperangia and conidia terminal and intercalary, in certain varieties orthosporic and others metasporic:

*E.* Antheridia mostly one in relation to a single oögonium; oöspores terminal and intercalary; conidia relatively few; hyphae regular, laterals without allantoid bodies; colony arachnoid to pulvinate; aerial mycelium moderately to well developed: *P. irregulare* (14)

*EE.* Antheridia mostly two in relation to a single oögonium, clavate, and supported on relatively long sickle shaped filaments; oöspores terminal and intercalary; conidia numerous; aerial mycelium strongly developed:

*P. polymorphon* (15)

*CCC.* Oöspores acanthophoric (spiny); oögonia smooth; subsection: *Acanthospora.*

*D.* Acanthae (spines) blunt and short; asexual reproduction mostly metasporic and occasionally orthosporic; prosperangia and conidia terminal and intercalary; hyphae regular; aerial mycelium moderately developed; antheridia mostly one in relation to a single oögonium; oöspores terminal and intercalary:

*P. mamillatum* (16)

*DD.* Acanthae long and sharp; asexual reproduction mostly metasporic; prosperangia mostly intercalary; antheridia mostly one



in relation to a single oögonium, hypogynous mostly and occasionally epigynous; oöspores terminal and intercalary; hyphae regular, laterals with allantoid bodies occasionally; aerial mycelium strongly developed; colony pulvinate to arachnoid:

*P. Artotrogus* (17)

BB. Oöspores plerotic and smooth; section: *Plerospora*.

C. Asexual reproduction orthosporic and metaspore; prosperangia intracellular and zoösporangia extracellular; conidia extracellular; oöspores in suitable culture media and tissues of hosts; antheridia mostly one in relation to an oögonium; hyphae irregular, laterals with blunt and swollen tips; colony slightly rosette; aerial mycelium moderately developed:

*P. diameson* (18)

CC. Asexual reproduction metaspore; conidia very rare; oöspores numerous, small in culture; antheridia mostly one in relation to an oögonium; hyphae regular, with blunt tips; colony strongly rosette; aerial mycelium either lacking or faintly developed:

*P. plerosporon* (19)

#### DESCRIPTION OF SPECIES

##### 1. *P. allantocladon* sp. nov. (FIG. 2, A AND 10).

Mycelium extracellular in culture media exhibiting a very weak aerial development; hyphae relatively regular in young cultures, main hyphae 4 to 7  $\mu$  and laterals 2 to 4  $\mu$  in diameter, the latter producing regularly, at their tips, allantoid structures measuring 8 to 12  $\mu$  in diameter, which may either germinate vegetatively or occasionally produce sexual organs; asexual reproduction metaspore; conidia subspherical, terminal and occasionally intercalary, extremely irregular in size, 12 to 25  $\mu$  in diameter, few and seldom produced on the allantoid hyphae; oögonia subspherical, 18 to 24  $\mu$  in diameter; lateral terminal or intercalary and may be produced occasionally on the hyphae arising from allantoid bodies; antheridia clavate to ascomorphic, 10 to 16  $\mu$  in length and 8 to 10  $\mu$  in diameter, surrounding oöspores after fertilization, as crescent shaped bodies; oöspores spherical intra- and extra-matrical, aplerotic, 10 to 20  $\mu$  in diameter, wall 1.2 to 1.8 in thickness, single, produced in 1- to 2-weeks-old cultures.

*Mycelio aërio brevi*; hyphis principibus uniformibus,  $4-7\ \mu$  diam., hyphis lateralibus gracillimis  $2-4\ \mu$ , cum apicibus incrassatis et doliformibus  $8-12\ \mu$ ; regeneratione asexuali metasporica; conidiis (pseudoconidiis) subsphaericis, terminalibus et intercalariis,  $12-25\ \mu$ ; oögoniis sphaericis, terminalibus et intercalariis,  $18-24\ \mu$ ; antheridiis claviformibus vel asciformibus,  $10-16 \times 8-10\ \mu$ ; oösporibus sphaericis, aperticis  $10-20\ \mu$ .

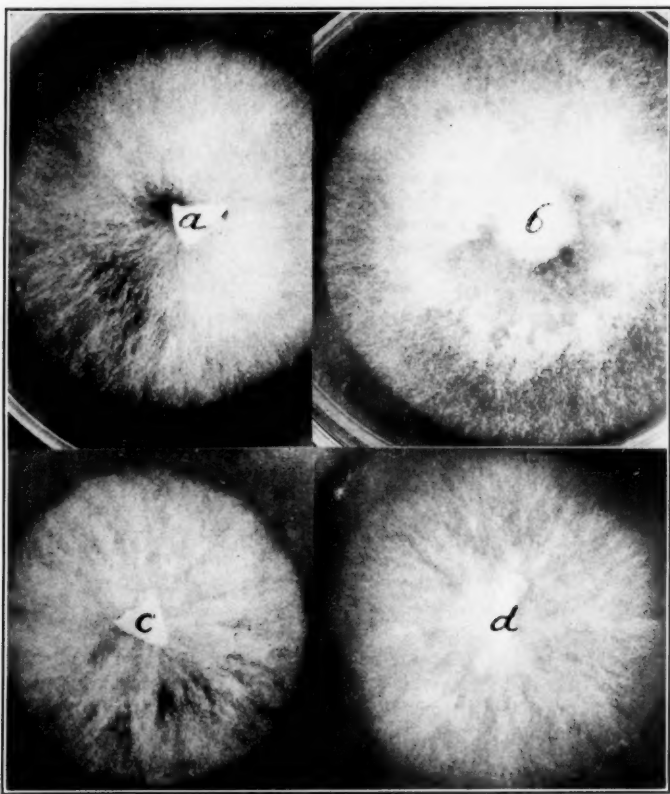


FIG. 1. Colonies 48 hours old on *Carica Papaya* agar; a, *P. araiosporon*; b, *P. Debaryanum*; c, *P. acanthophoron*; d, *P. diameson*.

It was first obtained together with other pythiaceous organisms from the diseased roots of *Spinacea oleracea* grown on the island of Oahu of the Hawaiian Archipelago. It failed to invade the

root tissues of *Ananas sativus* on inoculation and is considered to be a saprophyte.

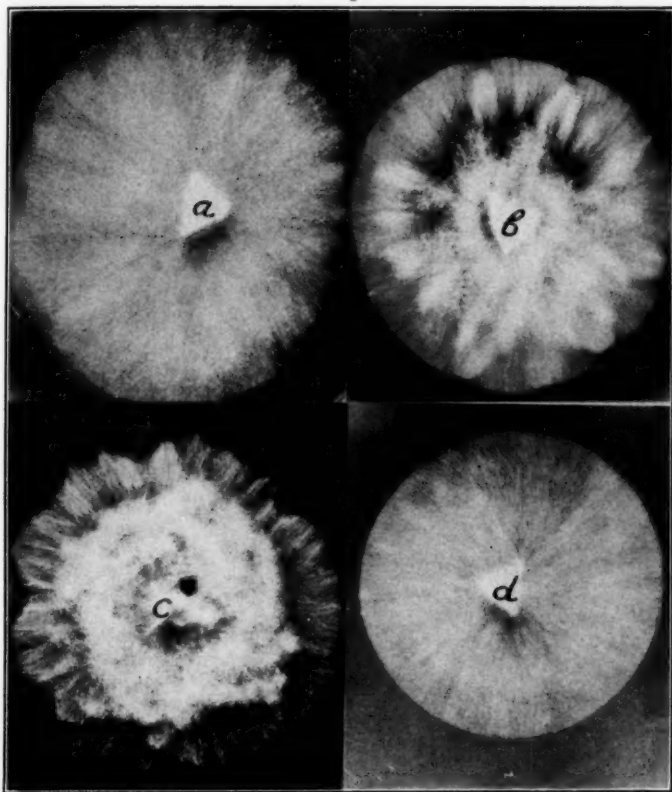


FIG. 2. Colonies 48 hours old on *Carica Papaya* agar: a, *P. allantoidon*; b, *P. ascophallon* (rosette); c, *P. polycladon* (rosette); d, *P. euthyhyphon* (radiate).

2. *P. ascophallon* sp. nov. (FIG. 2, B; FIG. 6, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>; FIG. 9).

Mycelium intra- and extra-cellular, in culture media (*Carica Papaya* agar) exhibiting a very good aerial development; hyphae relatively regular,  $6\mu$  in diameter, laterals slightly irregular, 3 to  $4\mu$  in diameter, may under certain conditions produce allantoid structures on submerged as well as aerial hyphae; asexual repro-

duction metaspore; conidia rare and of irregular size, analogous to the allantoid bodies of lateral hyphae; oögonia subspherical, lateral and occasionally intercalary, 16 to 25  $\mu$  in diameter, produced

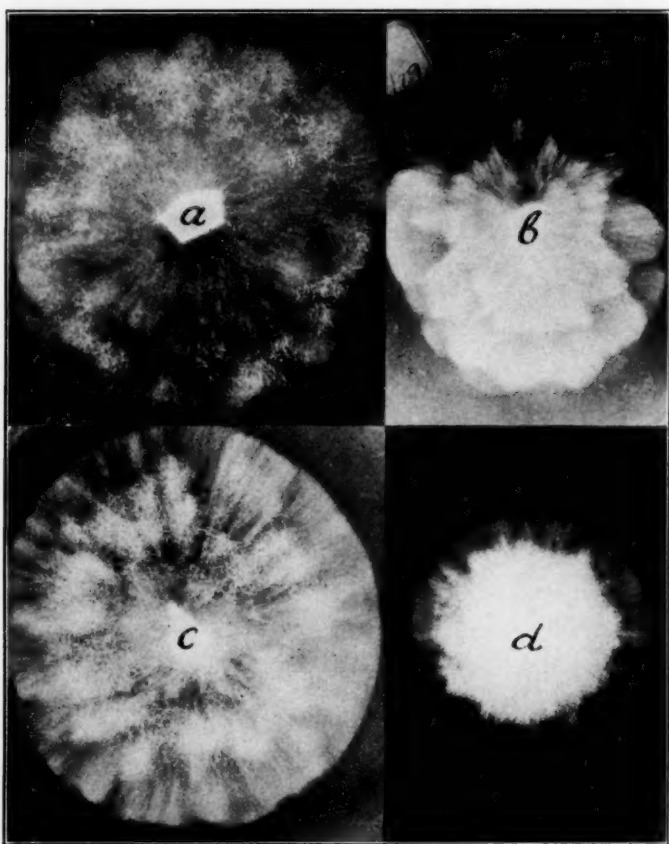


FIG. 3. Colonies 48 hours old on *Carica Papaya* agar: a, *P. mamillatum* (rosette); b, *P. plerosporon* (rosette); c, *P. complectens* (rosette); d, *P. intermedium*.

in groups first and later throughout the entire colony; antheridia ascomorphic before fertilization and may be falcate after fertilization, developing either on the same or on a different hypha from

that of the oogonium, 10 to 15  $\mu$  in length and 10 to 12  $\mu$  in diameter at the thickest point tapering gradually towards delimiting septum, with a fertilization tube located at the center of the apical surface area of the baglike antheridium, one in relation to a single oogonium; antheridium losing its initial shape by gradual collapsing and falling on oogonial wall, as fertilization proceeds and attachment between it and the oogonium becomes firmer (the original tip or fertilization tube of antheridium being the center of attachment stays in position while the peripheral area of baglike structure forms a crescent shaped body around oogonium) (FIG. 6, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>); oöspores spherical, intra- and extra-matrical, aplerotic, single, 12 to 18  $\mu$  in diameter, wall 1.0 to 1.5  $\mu$  in thickness, produced on suitable culture media and in the tissues of hosts.

Mycelio aerio plene maturo; hyphis principibus uniformibus 6  $\mu$ , hyphis lateralibus 3-4  $\mu$ , cum accretionibus allantiformibus intercalaribus et terminalibus; regeneratione asexuale metasporea; conidiis inaequalibus, infrequentibus; oogoniis subsphaericis, lateralibus et intercalaribus, 16-25  $\mu$ ; antheridiis asciformibus, 10-15  $\times$  10-12  $\mu$ ; oösporis sphaericis, apleroticis, 12-18  $\mu$ .

It was first obtained from the diseased roots of *Spinacea oleracea* grown on the island of Oahu of the Hawaiian Archipelago, and also from the roots of *Ricinus communis* grown on the grounds of the farm of the University of Hawaii. It was found, on inoculation, to be an extremely weak parasite of the roots of *Ananas sativus*.

3. *P. COMPLECTENS* Braun, Jour. Agr. Res. 29: 415. 1924 (FIG. 3, c; 8, E-F).

Mycelium intra- and extra-cellular in culture media exhibiting a weak to moderate aerial development, colony rosette; hyphae relatively regular, hyaline 2 to 5  $\mu$  in diameter with rounded tips forming a strongly parallel silky growth; asexual reproduction orthosporic and metasporeic, prosperangia and conidia 16 to 27  $\mu$  in diameter; zoösporangia 15 to 35  $\mu$  in diameter containing 8 to 24 reniform biciliate zoöspores measuring 8  $\mu$  in diameter, at rest; oogonia spherical to subspherical mostly on laterals, 18 to 25  $\mu$  in diameter; antheridia ascomorphic, size variable; oöspores spherical, 12 to 22  $\mu$  in diameter, single, aplerotic, wall 1.2 to 1.8  $\mu$  in thickness.

It was first obtained by Braun from *Coleus* and *Pelargonium* cuttings. The writer obtained it from the diseased roots of *Carica Papaya* grown on the island of Oahu of the Hawaiian Archipelago.

4. *P. polycladon* sp. nov. (FIG. 2, c; FIG. 5, c AND H; FIG. 14).

Mycelium intra- and extra-cellular in culture media exhibiting a profuse aerial development; hyphae regular 2 to 4  $\mu$  in diameter, laterals dichotomously branching at very short intervals; gemmae

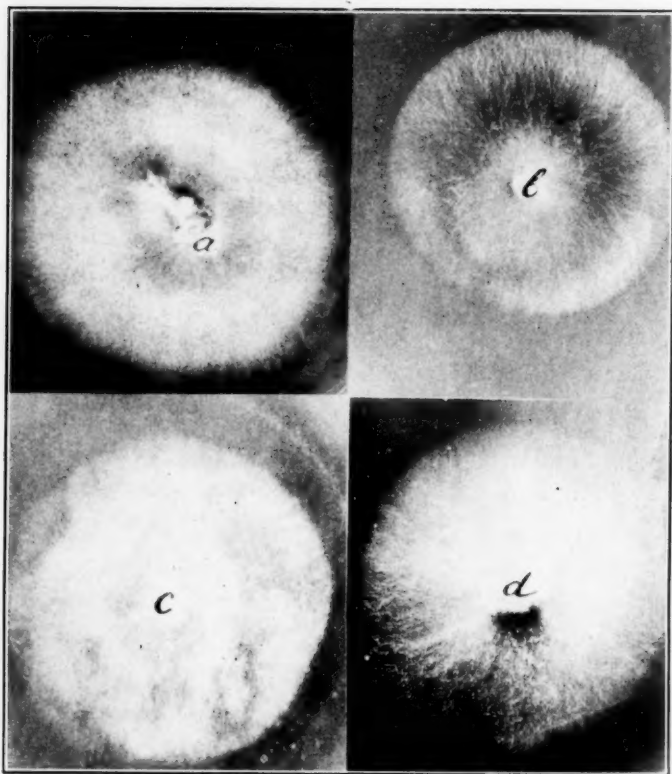


FIG. 4. Colonies on *Carica Papaya* agar: a, *P. irregulare* (48 hours old) (pulvinate); b, *P. polymorphon* (24 hours old) (pulvinate); c, *P. arto-trogum* (48 hours old) (arachnoid); d, *P. splendens* (24 hours old) (pulvinate).

often produced in unfavorable culture media, amorphous, germinating with many germ tubes; asexual reproduction orthosporic and metaspore; prosperangia subspherical or lemon-shaped, 18 to 24  $\mu$  in diameter, produced in favorable culture media and on the

surface of infected tissues of hosts; zoösporangia produced under favorable conditions, 24 to 32  $\mu$  in diameter containing 8 to 24 zoöspores, exit tube 7 to 10  $\mu$  long and 4  $\mu$  in diameter; conidia produced on single or occasionally on branched conidiophores, size and shape same as prosperangia; zoöspores reniform, biciliate, remaining motile from 10 to 30 minutes or possibly longer, then rounding up into subspherical bodies, 10  $\mu$  in diameter, which germinate a few hours later by one germ tube; oögonia and oöspores observed only in the tissues of hosts, never in culture media, about 20  $\mu$  in diameter. (The identity of oöspores in the tissues could not be definitely established owing to their rare development, their small number, and also to the optical difficulties encountered in detecting such hyaline structures as antheridia inside the tissues.)

Mycelio aërio plene maturo; hyphis uniformibus 2-4  $\mu$ ; gemmis infrequentibus; regeneratione asexuali orthosporica vel metasporica; prosperangii subsphaericis vel citronformibus, 18-24  $\mu$ ; zoösporangii, 24-32  $\mu$ ; zoösporis reniformibus, 8-24; tubis exitibus, 7-10  $\times$  4  $\mu$ ; conidiis (pseudoconidiis), 18-24  $\mu$ ; conidiophoris simplicibus vel ramosis; regeneratione sexuali infrequente.

It was first obtained from the diseased roots of *Ricinus communis* grown on the grounds of the University of Hawaii farm in Manoa, Oahu, Hawaiian Archipelago. It is a relatively weak parasite of the roots of *Ananas sativus*.

5. *P. chamaihyphon* sp. nov. (FIG. 15, G<sub>1</sub>-G<sub>5</sub>).

Mycelium in culture media (*Carica Papaya*) either exhibiting a very weak aerial development or lacking; hyphae regular 2 to 5  $\mu$  in diameter, laterals dichotomously branching at very short intervals; gemmae never observed; asexual reproduction orthosporic and metasporic, prosperangia subspherical, 15 to 25  $\mu$  in diameter, produced in favorable culture media, developing into zoösporangia readily under favorable conditions, 15 to 30  $\mu$  in diameter, and containing 4 to 24 zoöspores, exit tube 5  $\mu$  in diameter by 5  $\mu$  in length; conidia produced on simple conidiophores, size and shape same as prosperangia; zoöspores reniform, biciliate, remaining motile 10 to 30 minutes or longer, then rounding up into subspherical bodies, about 10  $\mu$  in diameter, which may germinate in a few hours by one germ tube; oögonia, antheridia and oöspores never observed in culture media.

Mycelio aërio typice brevi; hyphis uniformibus, 2-5  $\mu$ ; regeneratione asexuali orthosporica et metasporica; prosperangii subsphaericis, 15-25  $\mu$ ; zoösporangii, 15-30  $\mu$ ; zoösporis reniformibus, 4-24; regeneratione sexuali ignota.

It was first obtained from the diseased roots of *Carica Papaya* grown on the island of Oahu of the Hawaiian Archipelago.

6. *P. euthyhyphon* sp. nov. (FIG. 2, D; FIG. 5, D; FIG. 15).

Mycelium intra- and extra-cellular, in culture media (*Carica Papaya* agar) exhibiting a very weak aerial development; hyphae very regular,  $5\ \mu$  in diameter, laterals about  $3\ \mu$  in diameter with allantoid bodies  $10$  to  $15\ \mu$  in diameter developing in cultures of 1 to 3 weeks old, and possibly serving as storage organs, germinating under favorable conditions by one or more germ tubes; asexual reproduction orthosporic and metasporic, prosperangia subspherical or lemon-shaped,  $16$  to  $22\ \mu$  in diameter, developing on the surface of diseased tissues of hosts and in culture media; zoösporangia forming readily from prosperangia when diseased tissues of hosts are placed in water,  $22$  to  $28\ \mu$  in diameter, containing from 8 to 24 and possibly more zoöspores; exit tube  $3\ \mu$  in length by  $4\ \mu$  in diameter; zoöspores reniform, biciliate, remaining motile from 10 to 30 minutes and possibly a longer or shorter period, then rounding up into subspherical bodies,  $10\ \mu$  in diameter, which may germinate in a few hours; conidia identical in size and shape with prosperangia produced readily on *Cannabis sativa* agar and other culture media, germinating by a single germ tube; oögonia and oöspores, about  $18\ \mu$  in diameter, observed in the tissues of hosts but never in culture media, produced in the former case very rarely. (Their identity can be made out with great difficulty and uncertainty owing to the optical difficulties involved in detecting the antheridia in the tissues. Their size is practically the same as that of conidia and it is possible that they are conidia though conidia are rarely produced intracellularly.)

Mycelio aërio typice brevi; hyphis principibus uniformibus,  $5\ \mu$ , hyphis lateralibus,  $3\ \mu$ , cum apicibus allantiformibus; regeneratione asexuali orthosporica vel metasporica; prosperangiis subsphaericis vel citroniformibus,  $16$ – $22\ \mu$ ; zoösporangiis,  $16$ – $28\ \mu$ ; zoösporis reniformibus,  $8$ – $24$ ; regeneratione sexuali infrequente.

It was first obtained from the diseased roots of pineapple plants grown in the greenhouse. The planting material, shoots or suckers of unknown origin, was sent to the writer by the Agriculture Department of the Experiment Station. It was found upon inoculation to be a weak parasite of the roots of *Ananas sativus*.

7. *P. INTERMEDIUM* deBary, Bot. Zeit. 39: 554. 1881 (FIG. 3, D).



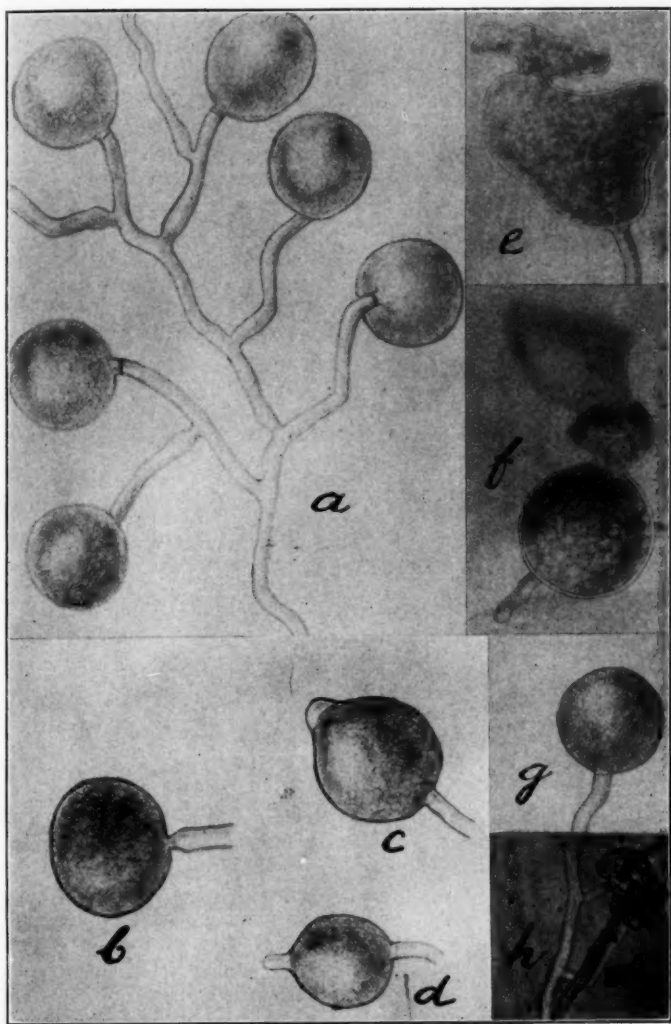


FIG. 5. Conidia or prosperangia and gemmae of *Pythium* spp.: a, *P. splendens* (branched conidiophore); b, *P. Debaryanum* (ellipsoid conidium); c, *P. polycladon* (citroid) (h) gemmae; d, *P. euthyhyphon*; e and f, *P. teratosporon* (teratomorphic conidia); g, *P. polymorphon* (spherical).

8. *P. acanthophoron* sp. nov. (FIG. 1, c; FIG. 6, F; FIG. 19).

Mycelium intra- and extra-cellular, aerial development in culture media either lacking or very weak; hyphae irregular slightly dendroid, 3 to 7  $\mu$  in diameter, laterals very short and irregular; asexual reproduction never observed; oögonia spherical, smooth, 20 to 30  $\mu$  in diameter, produced in great numbers in young as well as old cultures on suitable culture media, many not fertilized and some abortive; antheridia ascomorphic, vermiculate and allantoid borne either on the oögonial hypha or on other laterals, 10 to 20  $\mu$  in length by 4 to 8  $\mu$  in diameter with a slight constriction in the middle, tapering gradually towards delimiting septum; oöspores spherical, echinulate, 15 to 25  $\mu$ , without the spines and with the spines 20 to 32  $\mu$  in diameter, wall about 1.5  $\mu$  in thickness.

Mycelio aërio mediocriter maturo vel ferme nullo in culturis in patellis; hyphis irregularibus, dendriformibus, 3-7  $\mu$ ; regeneratione asexuali ignota; oögoniis sphaericis, levibus, 20-30  $\mu$ ; antheridiis asciformibus, vermiculatis, 10-20  $\times$  4-8  $\mu$ ; oösporibus sphaericis, echinulatis, 20-32  $\mu$ .

It was first obtained from the base of diseased leaves of *Ananas sativus* grown in the district of Paumalu, island of Oahu of the Hawaiian Archipelago. It was found on inoculation to be an extremely weak parasite of the roots of *Ananas sativus*.

9. *P. MEGALACANTHUM* deBary, 1881 (Verh. Senckenb. Ges. 12: 243 und Bot. Zeit. 39: 539, 1881). (FIG. 20-c).10. *P. DEBARYANUM* Hesse, *Pythium Debaryanum*, ein endophytischer Schmarotzer. 1874. Butler, E. J. (4) (FIG. 1, B; FIG. 5, B; FIG. 11).

Myceliun intra- and extra-cellular, in culture media exhibiting a strong aerial development; hyphae regular, 5 to 10  $\mu$  in diameter, laterals partly irregular, 3 to 6  $\mu$  in diameter; asexual reproduction metaspore; conidia (pseudoconidia) few, spherical to subspherical, 15 to 20  $\mu$  in diameter, germinating readily in water mostly by a single germ tube; oögonia spherical, smooth, mostly terminal, 20 to 25  $\mu$  in diameter, produced in the tissues of hosts and in culture media; antheridia clavate, agchylolaimic and mostly one in relation to a single oögonium, 12 to 16  $\mu$  in length by 8 to 10  $\mu$  in diameter, tapering gradually towards delimiting septum of supporting hypha, borne mostly on oögonial hyphae and occasionally on other hyphae; oöspores spherical, 16 to 22  $\mu$  in diameter, wall 1.5 in thickness, produced in appreciable numbers in the tissues of hosts and culture media.

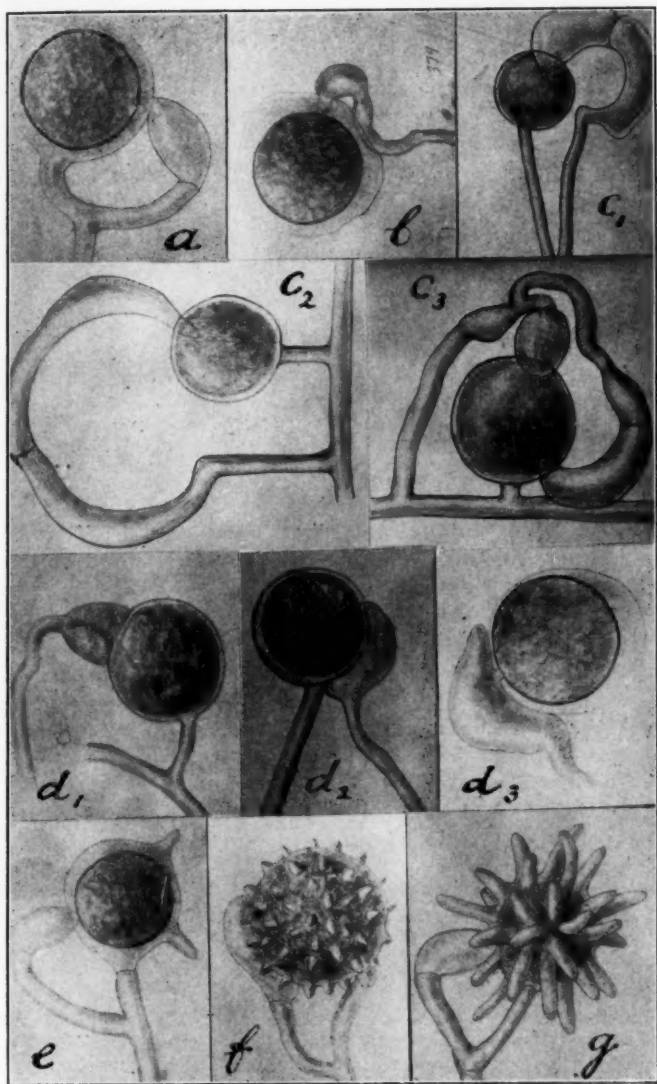


FIG. 6. Sexual organs of *Pythium* spp.: a, *P. diameson* (plerotic oöspore, clavate antheridium); b, *P. Debaryanum* (aplerotic oöspore, clavate antheridium); c<sub>1</sub>, c<sub>2</sub>, c<sub>3</sub>, *P. polymorphon* (polymorphic oöspore, clavate antheridium); d<sub>1</sub>, d<sub>2</sub>, d<sub>3</sub>, *P. ascophallon* (aplerotic oöspore, ascomorphic antheridium); e, *P. irregulare* (polymorphic oöspore, clavate antheridium); f, *P. acanthophoron* (acanthophoric oöspore, ascomorphic antheridium); g, *P. Artotrogus* (acanthophoric oöspore, clavate antheridium).

It was obtained from the diseased roots of *Ananas sativus* grown on the islands of Oahu and Maui of the Hawaiian Archipelago. It is a moderate to a weak parasite of the roots of *Ananas sativus*, *Canavalia ensiformis*, *Ipomoea Batatas*, *Solanum tuberosum*, *Vicia faba*, *Zea Mays*, *Vigna sinensis* and *Cajanus indicus*.

11. ***P. araiosporon*** sp. nov. (FIG. 1, A; FIG. 8).

Mycelium on culture media producing a weak to moderate aerial development; colony radiate; hyphae mostly regular, 6 to 12  $\mu$  (average 8  $\mu$ ) in diameter, laterals 3 to 5  $\mu$  with a very prominent constriction at their base; asexual reproduction never observed; oögonia spherical to subspherical, mostly intercalary and occasionally catenulate, 30  $\mu$  in diameter, few on highly suitable substrata (*Carica Papaya*, etc.); antheridia clavate, agchylolaimic, 10  $\mu$  in length along axis from apex to basal septum and 5  $\mu$  in diameter at the distal expanded portion, produced mostly on oögonial hyphae; oöspores spherical, aplerotic, 16 to 22  $\mu$  in diameter, mostly intercalary and catenulate, wall 2  $\mu$  in thickness, produced in very few numbers in highly suitable substrata.

Mycelio aerio typice brevi; hyphis uniformibus, 6-12  $\mu$ ; ramis in basis constrictis; regeneratione asexuali ignota; oögoniis sphaericis, 30  $\mu$ ; antheridiis clavatis cum collis curvatis, 10  $\times$  5  $\mu$ ; oösporibus sphaericis, apleroticis, intercalaribus et catenulatis.

It was isolated by the author from the diseased roots of *Carica Papaya* grown in Manoa Valley, island of Oahu, Hawaiian Archipelago. A culture of this same organism was also sent to the writer by Dr. W. D. Valleau of the University of Kentucky, from the diseased roots of tobacco.

12. ***P. splendens*** var. ***hawaiianum*** var. nov. (FIG. 4, D; FIG. 5, A; FIG. 12). (Braun 2)

Mycelium intra- and extra-cellular, in culture media (*Carica Papaya* agar) exhibiting a strong aerial development; hyphae regular, laterals irregular, 5 to 8  $\mu$  in diameter; asexual reproduction metasporeic; conidia (pseudoconidia) very abundant intra- or extra-matrical spherical to subspherical or ellipsoid, 30 to 45  $\mu$  in diameter, mostly terminal and occasionally intercalary, germinating vegetatively in water in a few hours; oögonia and antheridia never observed either in young or old cultures on different substrata; oöspores observed only in the tissues of hosts, 17 to 25  $\mu$  in diameter (the presence or identity of the antheridia has never been established satisfactorily); differing from *P. splendens* Braun in

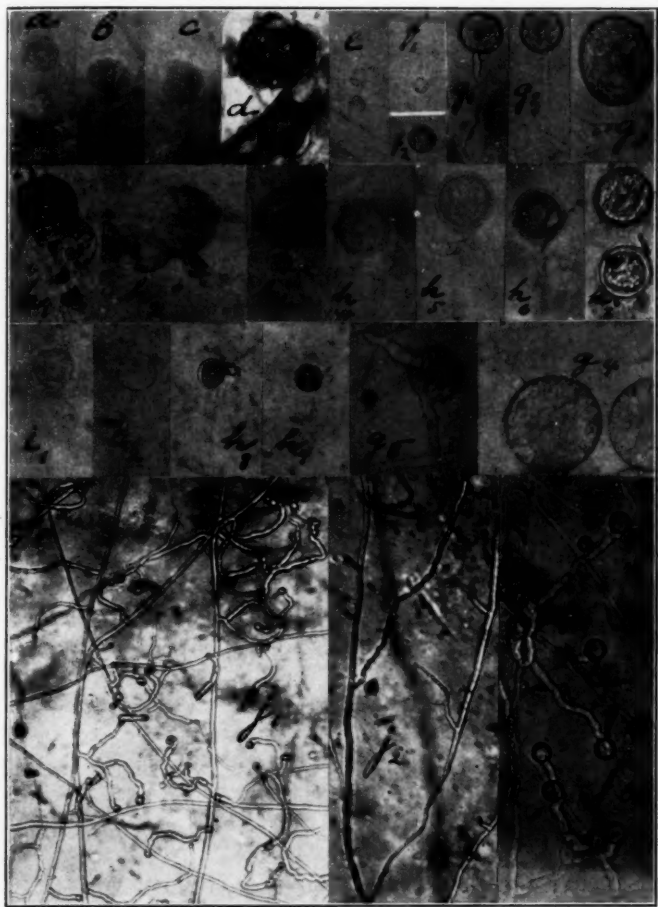


FIG. 7. *Pythium diameson* Sideris: a, b, c, zoösporangia ( $\times 300$ ); d, prosporangium intracellular, zoösporangium extracellular ( $\times 600$ ); e, f, zoöspores ( $\times 300$ ), f<sub>2</sub>, ( $\times 600$ ); g<sub>1</sub>, g<sub>2</sub>, conidia ( $\times 300$ ); g<sub>3</sub>, germinating; g<sub>4</sub>, g<sub>5</sub>, conidia ( $\times 600$ ); h<sub>1</sub>-h<sub>4</sub>, sexual organs and oöspores ( $\times 600$ ); h<sub>5</sub>-h<sub>8</sub>, sexual organs ( $\times 300$ ); i<sub>1</sub>-i<sub>2</sub>, empty prosporangia ( $\times 300$ ); j<sub>1</sub>-j<sub>2</sub>, hyphae ( $\times 150$ ); j<sub>3</sub>, hyphae ( $\times 300$ ) (in unfavorable culture media).

the stronger aerial mycelial development and the size of the conidia, which measure on an average about  $5\ \mu$  more in diameter.

It was first obtained from diseased pineapple roots grown in various fields and in the greenhouses of the Experiment Station at Wahiawa on the island of Oahu of the Hawaiian Archipelago. It is a very aggressive parasite of the roots of *Ananas sativus*, a moderate one of the roots of *Cajanus indicus*, *Phaseolus aureus*, *Vigna sinensis*, *Vicia faba*, *Triticum vulgare*, *Ipomoea Batatas*, *Canavalia ensiformis*, *Helianthus annuus* and a weak one of those of *Saccharum officinarum* var. Lahaina.

13. *P. teratosporon* sp. nov. (FIG. 5, E AND F; FIG. 13).

Mycelium intra- and extra-cellular, on culture media (*Carica Papaya*) exhibiting a strong aerial development; colony slightly zonate and arachnoid; hyphae regular, 7 to  $10\ \mu$  (average  $8.5\ \mu$ ) in diameter; asexual reproduction metaspore; conidia spherical to subspherical or teratomorphic, that is, of irregular and monstrous shapes; oögonia spherical intra- and extra-cellular, 22 to  $28\ \mu$  in diameter, occurring in the tissues of hosts, but never observed in culture media; antheridia never observed; oöspores spherical, aplerotic, 18 to  $22\ \mu$  in diameter, observed in the tissues of the roots of *Cajanus indicus*.

Mycelio aerio plene maturo; colonis zonatis et arachniformibus; hyphis uniformibus, 7-10  $\mu$ ; regeneratione asexuale metasporica; conidiis subsphaericis et teratoformibus; oögoniis sphaericis, 22-28  $\mu$ ; oösporis sphaericis, apleroticis, 18-22  $\mu$ .

It was obtained from the diseased roots of *Spinacea oleracea* grown on the island of Oahu of the Hawaiian Archipelago. It was found to be a very weak parasite on inoculation on the roots of *Ananas sativus* and *Zea Mays* and a moderate one on those of *Cajanus indicus* var. New Era and *Allium Cepa*. This organism is one of those whose position is doubtful. Its only relationship in the genus *Pythium* is that with *P. splendens* Braun and in *Phytophthora*, judging from its mycelium, with *P. parasitica*, which is also very remote. It is more closely related to *Pseudopythium phytophthoron* than to any other organism in the Pythiaceae.

14. *P. irregulare* Buisman, var. *hawaiiense* var. nov. (FIG. 4, A; FIG. 6, E; FIG. 16). (Buisman, C. J. 2)

Mycelium intra- and extra-cellular, in culture media exhibiting moderate to weak aerial development; hyphae relatively regular,

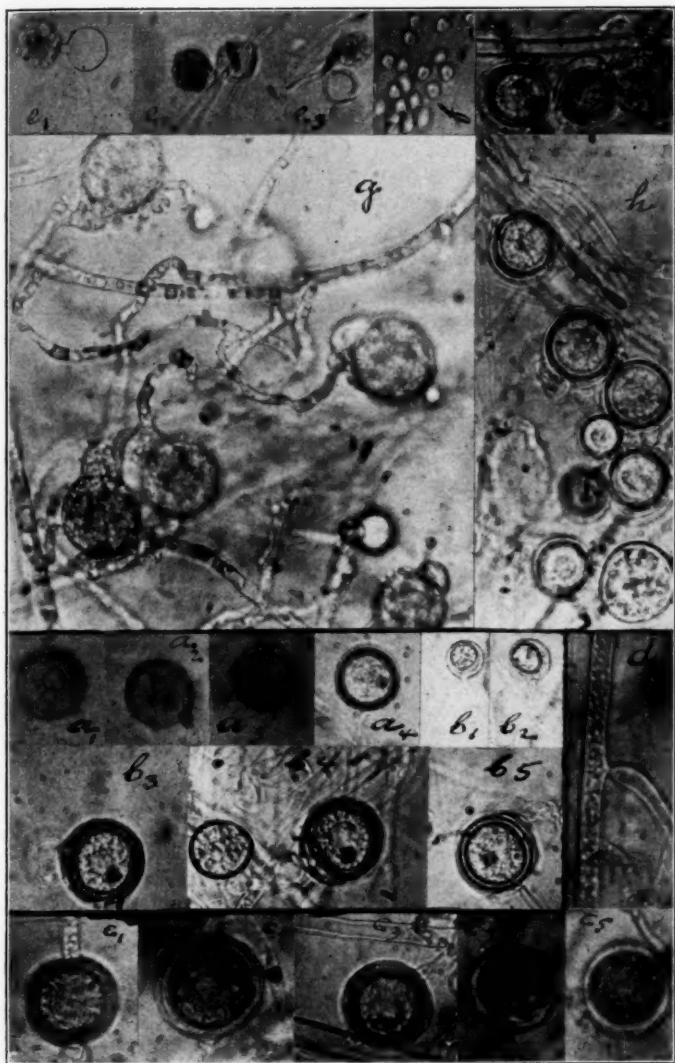


FIG. 8. *Pythium plerosporon* Sideris: (a-b) a<sub>1</sub>-a<sub>4</sub> and b<sub>1</sub>-b<sub>5</sub>, oöspores (× 600); b<sub>1</sub>-b<sub>2</sub>, sexual organs (× 300). *Pythium araiosporon* (c-d): c<sub>1</sub>-c<sub>5</sub>, oöspores (× 300); d, hyphae (× 600). *Pythium complectens* Braun. (e-f): e<sub>1</sub>-e<sub>5</sub>, prosperangia and zoösporangia (× 300); f, zoöspores (× 300); g, sexual organs (× 600); h, oöspores (× 600).



3 to  $6\ \mu$  in diameter; asexual reproduction metasporeic; conidia rare, 20 to  $25\ \mu$  in diameter, mostly intercalary; oögonia spherical to subspherical, 18 to  $22\ \mu$  in diameter, smooth, borne mostly on laterals, terminal and intercalary; antheridia clavate, slightly or decidedly curved, 10 to  $15\ \mu$  in length along axis from apex to the delimiting septum of supporting filament and 6 to  $9\ \mu$  in diameter, one or as many as four in relation to an oögonium; oöspores smooth to echinulate, aplerotic, 12 to  $18\ \mu$  in diameter, cell wall 1 to  $1.2\ \mu$  in thickness, number of spines indefinite, from one to many, 2 to  $8\ \mu$  in length by  $2.5\ \mu$  in diameter; it differs from *P.*

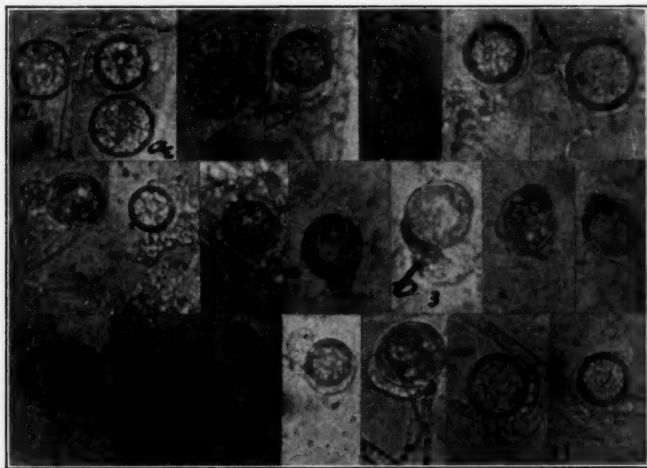


FIG. 9. *Pythium ascophallon* Sideris: *a*<sub>1</sub>, *a*<sub>2</sub>, oögonia ( $\times 600$ ); *b*<sub>1</sub>, *b*<sub>2</sub>, beginning fertilization ( $\times 300$ ); note ascomorphic antheridium; *b*<sub>3</sub>, *b*<sub>4</sub>, recently fertilized ( $\times 600$ ); unlabeled illustrations are oöspores ( $\times 600$ ).

*irregulare* Buisman (3) in the size of the oöspores, fewer conidia, nonproduction of zoöspores and stronger aerial mycelium development.

It was first obtained from the diseased roots of *Ananas sativus* grown on the island of Oahu of the Hawaiian Archipelago. It was found on inoculation to be a moderate to severe parasite on the roots of *Ananas sativus*, *Cajanus indicus*, *Phaseolus aureus*, *Vicia faba*, *Ipomoea Batatas*, *Canavalia ensiformis* and *Helianthus annuus*.



15. *P. polymorphon* sp. nov. (FIG. 4, B; FIG. 6,  $c_1$ ,  $c_2$ ,  $c_3$ ; FIG. 17).

Mycelium intra- and extra-cellular, in culture media (*Carica Papaya*) exhibiting a very profuse aerial development; hyphae

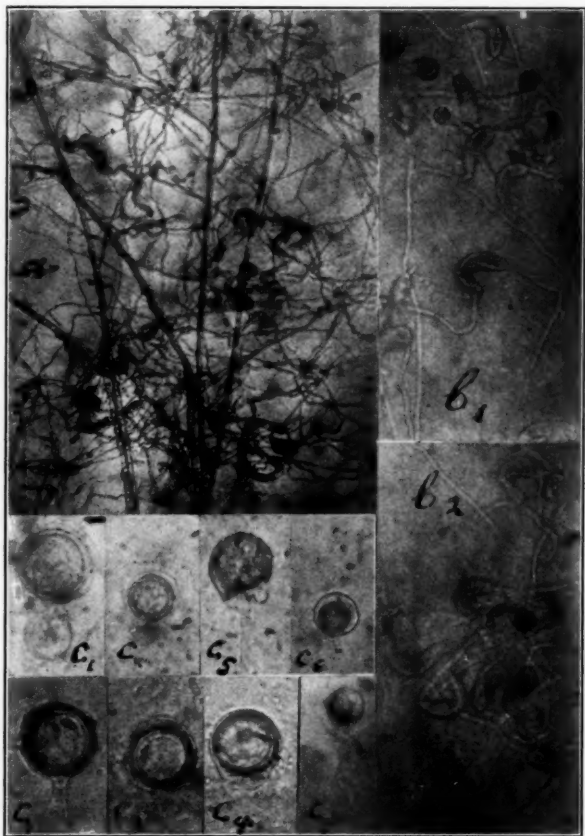


FIG. 10. *Pythium allantocladon* Sideris: a, hyphae with allantoic bodies ( $\times 300$ );  $c_1$ - $c_4$ , oöspores ( $\times 600$ );  $c_5$ , recently fertilized oögonium ( $\times 600$ );  $c_6$ , recently fertilized ( $\times 300$ );  $c_7$ , oöspore at the tip of an allantoic body.

mostly regular,  $8\mu$  in diameter, laterals  $4\mu$  in diameter; asexual reproduction metaspore; conidia subspherical to ellipsoid, 20 to  $40\mu$  (average  $30\mu$ ) in diameter, many, and mostly intercalary on

aerial mycelium; oögonia subspherical, 20 to 22  $\mu$  in diameter, smooth, terminal and intercalary, mostly on laterals; antheridia clavate, 7.5  $\mu$  in diameter in the distal expanded portion by 8 to 12  $\mu$  in length along axis from apex to basal septum, supporting

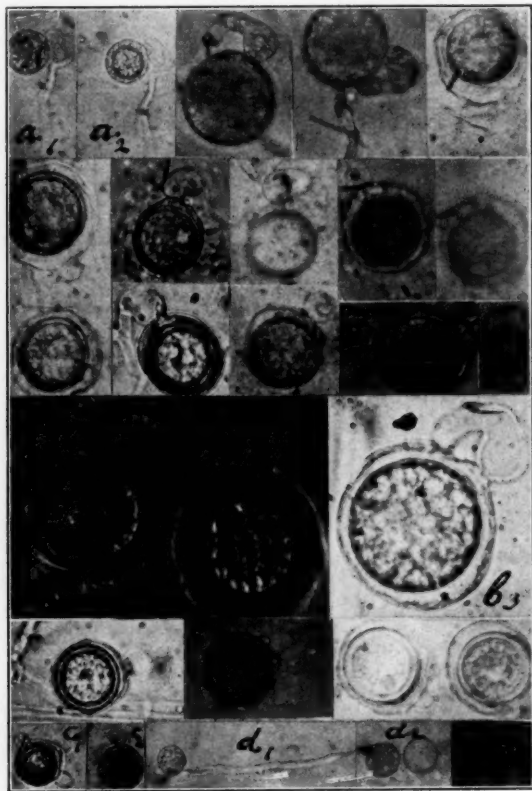


FIG. 11. *Pythium Debarianum* Hess.:  $a_1, a_2$ , oögonium (the same) at the beginning of fertilization and 30 minutes later ( $\times 300$ );  $b_1, b_2, b_3$ , oöspores ( $\times 1000$ );  $c_1, c_2, c_3$ , oöspores ( $\times 300$ );  $d_1, d_2$ , conidia ( $\times 300$ ); unlabeled illustrations are oöspores at different stages ( $\times 600$ ).

filament falcate to sigmoid, relatively long and originating either from the oögonial hypha or some other; two mostly in relation to a single oögonium and often one or three; oöspores spherical to subspherical, aplerotic, 17 to 20  $\mu$  in diameter, wall 1.2  $\mu$  in thick-

ness, some smooth and others echinulate, number of spines one to many. It has been observed that culture media favoring the production of many conidia inhibit that of oöspores and vice versa. *Carica Papaya* media treated with 1.0 gram of  $K_2HPO_4$  favor the development of oöspores while inhibiting at the same time that of conidia. Untreated *Carica Papaya* media behave in the opposite direction.

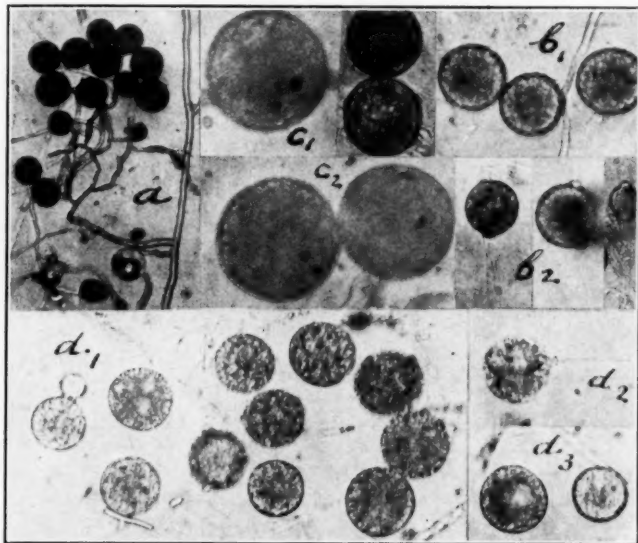


FIG. 12. *Pythium splendens* Braum var. *hawaiiianum* (a-c): a, conidiophore (branched) and conidia ( $\times 150$ ); b<sub>1</sub>, b<sub>2</sub>, terminal and intercalary conidia ( $\times 300$ ); c<sub>1</sub>, c<sub>2</sub>, terminal conidia ( $\times 600$ ). *P. splendens* Braum: d<sub>1</sub>-d<sub>3</sub>, conidia ( $\times 300$ ).

Mycelio aërio plene maturo; hyphis uniformibus, 4-8  $\mu$ ; regeneratione asexuali metasporica; conidiis subsphaericis, ellipticis, intercalariis et terminalibus, 20-40  $\mu$ ; oögoniis sphaericis, levibus, terminalibus et intercalariis, 20-22  $\mu$ ; antheridiis clavatis, 8-12  $\times$  6-7.5  $\mu$ ; oösporibus sphaericis, apleroticis, levibus vel echinulatis, 17-20  $\mu$ .

It was obtained from diseased roots of *Ananas sativus*. Also a similar culture was sent to the writer by Dr. W. D. Valleau of the University of Kentucky, isolated from the diseased roots of tobacco. It was found on inoculation to be moderately to aggressively parasitic on the roots of *Ananas sativus*.

16. *P. MAMILLATUM* Meurs. (FIG. 20, B).

(Ein neuer Würzelbranderreger der Zucker- und Futterrüben, Phytopathologische Zeitschrift 1: 111-116. 1929.)

Mycelium intra- and extra-cellular, in culture media exhibiting a weak to moderate aerial development; colony slightly rosette; hyphae fairly regular, 5 to 8  $\mu$  in diameter; asexual reproduction mostly metaspore, rarely orthospore, prosperangia and conidia spherical, 14 to 21  $\mu$  in diameter; oögonia spherical to subspherical, 20 to 30  $\mu$  in diameter, terminal or intercalary; antheridia clavate,

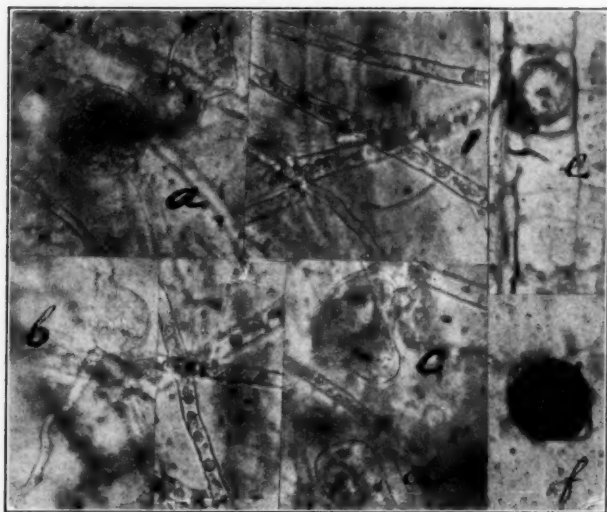


FIG. 13. *Pythium teratosporon* Sideris: a, b, c, d, conidia ( $\times 300$ ); e, f, oöspores ( $\times 600$ ).

10 to 15  $\mu$  in length by 6  $\mu$  in diameter; oöspores spherical, spiny, with the spines 20.3 to 29.3  $\mu$  in diameter, without the spines 13.0 to 19.3  $\mu$  (average 16.4  $\mu$ ), cell wall 0.8 to 1.6  $\mu$  in thickness, spines blunt 2.7 by 6.0  $\mu$ .

It was first obtained by Meurs (7) from the diseased roots of *Beta vulgaris*. It is a weak to moderate parasite of the roots of *Ananas sativus*.

17. *P. Artotrogus* (Montagne) deBary var. *macracanthum* var. nov. (FIG. 4, c; FIG. 6, g; FIG. 18).

(*Artotrogus hydnosporus* Montagne; Berk. Gard. Chron., 1845: 640, and Jour. Royal Hort. Soc. 1: 33. 1846.) (deBary, A. Verh. Senck. Ges. 12: 1881, pl. I.) ; Butler (4).

Mycelium intra- and extra-cellular, in culture media (*Carica Papaya*, etc.) exhibiting a strong aerial development; hyphae branching, 3 to 6  $\mu$  in diameter, laterals occasionally with allantoid bodies; asexual reproduction mostly metaspore; conidia spherical to subspherical, 20 to 30  $\mu$  in diameter, mostly intercalary; oögonia spiny, terminal and very often intercalary, 20 to 30  $\mu$  in diameter, produced intra- and extra-cellularly; antheridia unicellular, cylindrical to club shaped tapering gradually towards delimiting septum, 10 to 14  $\mu$  in length by 5 to 7  $\mu$  in diameter, hypogynous or epigynous, mostly one in relation to a single oögonium; oöspores, echinulate, 15 to 25  $\mu$  in diameter without the spines and with the spines 30 to 45  $\mu$  in diameter, cell wall 1.5 to 2.0  $\mu$  in thickness, spines 7.5 to 10  $\mu$  in length by 1.0 to 1.5  $\mu$  in diameter. It differs from *P. Artotrogus* (Mont.) deBary (FIG. 20-A) in having some epigynous antheridia in the greater length of the spines of its oöspores and the greater amount of aerial mycelium produced by culture media.

It was first obtained from the diseased roots of *Ananas sativus* grown on the islands<sup>1</sup> of Oahu and Maui of the Hawaiian Archipelago. The organism was found on inoculation to kill the roots of *Ananas sativus*, *Saccharum officinarum* var. *Lahaina*, *Pennisetum barbinodum*, *Cajanus indicus*, *Phaseolus aureus*, *Ipomoea Batatas*, *Canavalia ensiformis* and *Vigna sinensis*.

18. *P. diameson* sp. nov. (FIG. 1, d; FIG. 6, a; FIG. 7).

Mycelium intra- and extra-cellular, in culture media exhibiting a weak to moderate aerial development; hyphae irregular, about 5  $\mu$  in diameter with constrictions, swellings, and occasionally few spiroid formations, laterals short terminating to cylindrical or slightly clavate branches with blunt and partly swollen tips; asexual reproduction orthospore and metaspore, prosperangia subspherical, 15 to 20  $\mu$  in diameter, mostly intracellular, producing zoösporangia extracellularly, the latter measuring about 25  $\mu$  in diameter and containing 8 to 24 zoöspores, exit tube piercing the cell wall of the host before emergence of zoösporangium takes place; conidia subspherical same size as prosperangia pro-

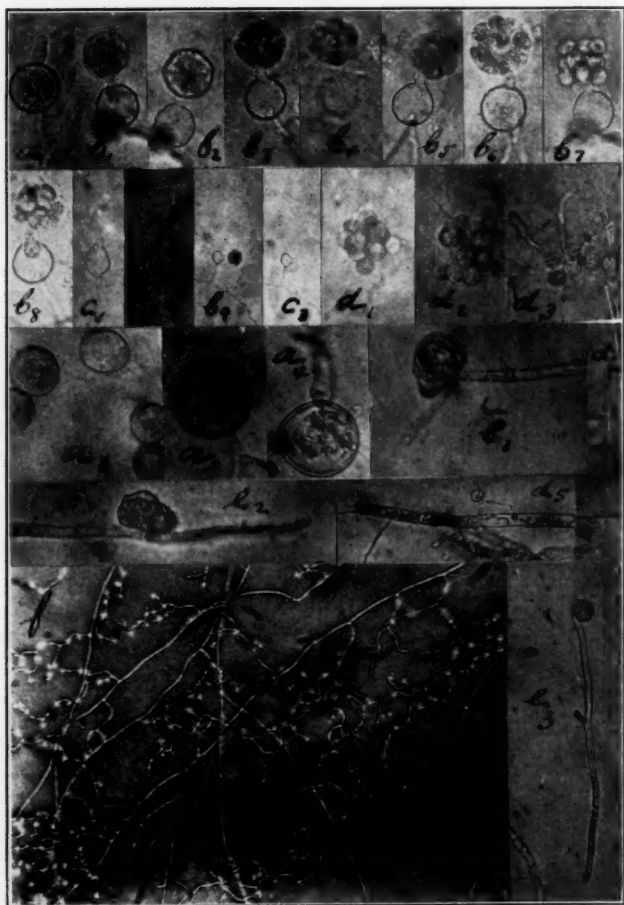


FIG. 14. *Pythium polycladon* Sideris:  $a_1$ , prosporangium ( $\times 300$ );  $a_2$ , conidia ( $\times 300$ );  $a_3$ ,  $a_1$ , conidia, one having germinated ( $\times 600$ );  $b_1$ - $b_5$ , prosporangia with zoösporangia and different stages in the development of zoöspores ( $\times 300$ ) except  $b_5$ , ( $\times 150$ );  $c_1$ - $c_3$ , empty prosporangia ( $\times 300$ );  $c_3$ , ( $\times 150$ );  $d_1$ - $d_3$ , germinating zoöspores ( $\times 300$ );  $d_4$ , zoöspore entering a root hair and  $d_5$  having entered it;  $e_1$ - $e_3$ , gemmae ( $\times 600$ );  $e_3$ , ( $\times 300$ );  $f$ , type of branching of hyphae ( $\times 150$ ).

duced in culture media, borne on the tips of unbranched or single conidiophores; zoöspores reniform with slightly pointed ends and a curvature at a deep hilum, motility lasting 5 to 15 minutes, then rounding up into subspherical bodies, 8 to 10  $\mu$  in diameter which may germinate in a few hours by one and rarely by two germ tubes;

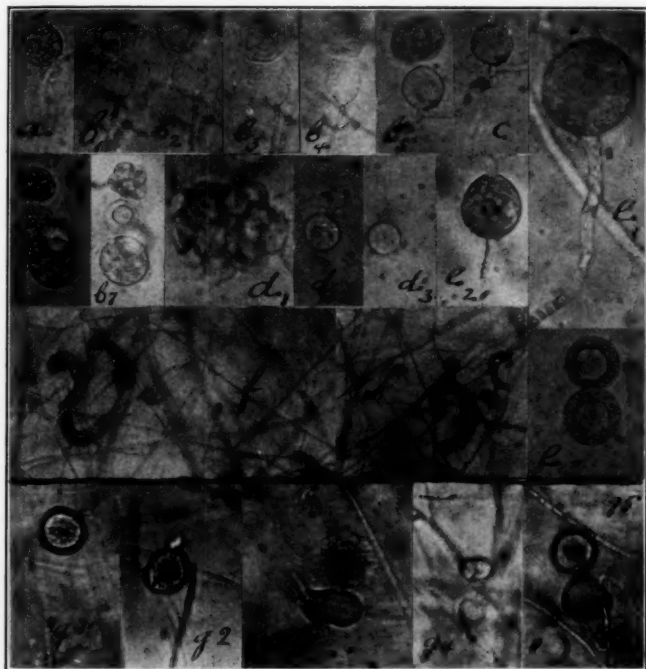


FIG. 15. *Pythium eutryhyphon* Sideris: *a*, prosporangium ( $\times 300$ ); *b*<sub>1</sub>-*b*<sub>5</sub>, prosporangia with zoösporangia and different stages in the development of zoöspores ( $\times 300$ ); *c*, empty prosporangium; *d*<sub>1</sub>-*d*<sub>5</sub>, zoöspores ( $\times 600$ ); *e*<sub>1</sub>, conidium ( $\times 600$ ); *e*<sub>2</sub>-*e*<sub>5</sub>, conidia ( $\times 300$ ); *f*, hyphae and allantoid bodies. *Pythium chamaihyphon* Sideris: *g*<sub>1</sub>, prosporangium before germination ( $\times 300$ ); *g*<sub>2</sub>, prosporangium discharging contents ( $\times 300$ ); *g*<sub>3</sub> and *g*<sub>5</sub>, prosporangia and zoösporangia ( $\times 300$ ).

oögonia intra- and extra-cellular, lateral and occasionally intercalary; spherical to subspherical, thin walled, measuring 15 to 17  $\mu$  in diameter; antheridia, clavate, oögonial hyphae, 9 to 11  $\mu$  in length by 4 to 6  $\mu$  in diameter, one and occasionally two in relation to a single oögonium; oöspores spherical intra- and extra-cellular,

plerotic, single, about  $15\ \mu$  in diameter, wall  $1\frac{1}{2}$  to  $2\ \mu$  in thickness, produced in great numbers in suitable culture media and in the tissues of hosts.

Mycelio aërio mediocri; hyphis irregularis,  $5\ \mu$ ; regeneratione asexuali orthosporica et metasporica; prosperangiiis sphaericis, intercellularibus et extracellularibus,  $15\text{--}20\ \mu$ ; zoösporibus reniformibus,  $8\text{--}24\ \mu$ ; conidiis subsphaericis; oögoniis intracellularibus et extracellularibus, subsphaericis,  $15\text{--}17\ \mu$ ; antheridiis clavatis; oösporibus sphaericis, apleroticis, singularibus,  $15\ \mu$ .

It was first obtained from the diseased roots of *Ananas sativus* grown in Field No. 209 of the Maui Agricultural Company on the island of Maui. It was found on inoculation, to be pathogenic on the roots of *Ananas sativus*, *Pennisetum barbinodum*, *Zea Mays*, *Saccharum officinarum* var. Lahaina, *Cajanus indicus*, *Vicia faba*, *Solanum tuberosum*, *Ipomoea Batatas*, and *Canavalia ensiformis*.

19. *P. plerosporon* sp. nov. (FIG. 3, B; FIG. 8).

Mycelium lacking aerial development on culture media; colony rosette; hyphae regular, 2 to  $5\ \mu$  (average  $3.5\ \mu$ ) in diameter; asexual reproduction extremely rare, metasporic; oögonia spherical, 16 to  $20\ \mu$  in diameter, mostly intramatrical on laterals; antheridia clavate, 10 to  $14\ \mu$  in length along axis from apex to basal septum by 8 to  $10\ \mu$  in diameter at the distal expanded portion, mostly on oögonial hyphae, mostly one in relation to a single oögonium; oöspores spherical, mostly terminal, plerotic, 12 to  $18\ \mu$  (average  $15\ \mu$ ) in diameter, wall 1 to  $2\ \mu$  in thickness, germinating by a single germ tube, occasionally by more.

Mycelio aërio mediocriter maturo vel ferme nullo in culturis in patellis; coloniis "rosette"; hyphis uniformibus,  $2\text{--}5\ \mu$ ; regeneratione asexuali infrequente, metasporica; oögoniis sphaericis,  $16\text{--}20\ \mu$ ; antheridiis clavatis,  $10\text{--}14 \times 8\text{--}10\ \mu$ ; oösporibus sphaericis, terminalibus, pleroticis,  $12\text{--}18\ \mu$ .

It was sent to the writer by Dr. W. D. Valleau of the University of Kentucky, obtained from the diseased roots of tobacco.

#### DISCUSSION

The attempt has been made in the foregoing pages to present a classification of the different members of *Pythium* from a different point of view than the one heretofore presented by other investigators. Characters that previously occupied a secondary or tertiary position are given a primary position in this presentation and vice versa. The writer's point of view is that morphological char-



acters associated with the sexual reproductive organs are liable to undergo slower changes and, therefore, are more stable than those associated with the asexual reproductive organs. The morphology of the oöspores and, to a certain extent, of the antheridia of all species of *Pythium* is fairly constant except for normal varia-

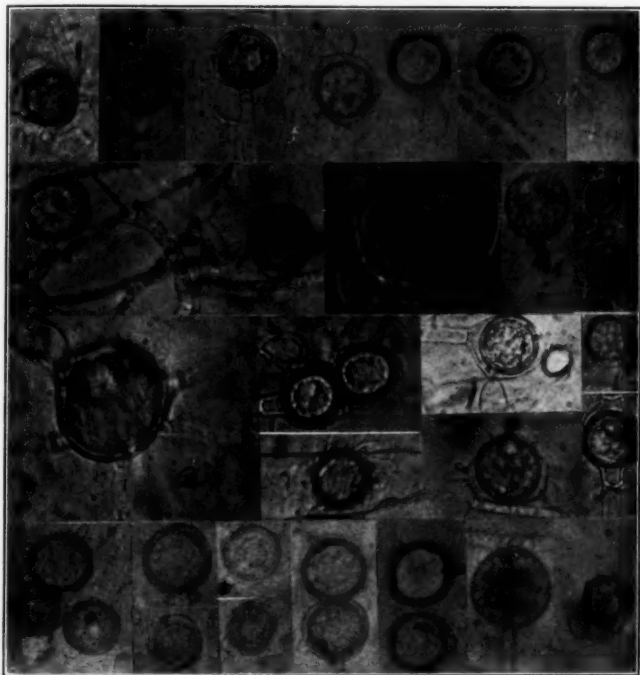


FIG. 16. *Pythium irregulare* Buisman var. *hawaiiianum*: a, b, oöspores (polymorphic) ( $\times 1000$ ); c, oögonium and oöspores ( $\times 300$ ); unlabeled illustrations are oöspores and oögonia ( $\times 600$ ).

tions. They are not susceptible to slight changes in their environment and nutrition. Furthermore morphological similarities of these organs between different species can be relied upon as representing some sort of relationship between such species.

With this point in view, the relationship existing between different species may be approximately ascertained by the common

characters existing in their antheridia and oöspores. There are four distinct types of oöspores (1) the smooth plerotic, (2) the smooth aplerotic, (3) the polymorphic aplerotic, and (4) the acanthophoric. There are, likewise, two distinct types of antheridia (1) the clavate and (2) the ascomorphic. The allantoid type of antheridium is but a slightly modified form of the ascomorphic type.

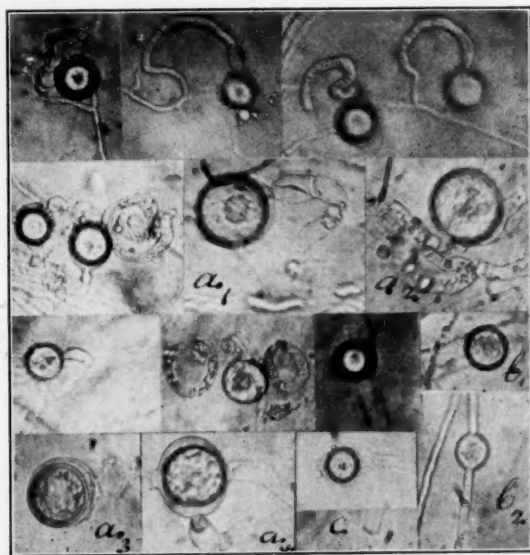


FIG. 17. *Pythium polymorphon* Sideris:  $a_1$ - $a_4$ , sexual organs ( $\times 600$ );  $b_1$ ,  $b_2$ , conidia ( $\times 300$ );  $c$ , oöspore with one spine ( $\times 300$ ); unlabeled illustrations are sexual organs ( $\times 300$ ).—Note type of antheridium.

It may be beyond our experimental possibilities to establish the precedence of any one of the different types of oöspores or antheridia in the evolution of the different species of *Pythium*. But by comparative morphological studies and reasoning, we are led to accept the smooth aplerotic type of oöspore and the ascomorphic type of antheridium as being the most elementary types. The aplerotic type of oöspore, that is, the one not filling the oögonium, occurs in the majority of the species of *Pythium*, and may be

fertilized by the clavate or ascomorphic type of antheridium. The ascomorphic type represents the most elementary type of antheridium owing to its initial shape and the modifications it undergoes during its development and after fertilization, which suggest its prototypic condition. The development of the other types of oöspores and antheridia has come about either by reduction of the original size or in the case of certain oöspores by modifications of the unfilled portion of the oögonium.

The evolution of the different species of *Pythium* as represented in figure 21 does not follow a straight line. It is very difficult to trace the descent of either the genus or the different species or the evolutionary development of their sexual organs with the small number of species already known. The number of prototypic organisms known is very small and not even sufficiently elementary for studies dealing with the evolution of such a complex genus as *Pythium*. The relationship existing between *Pythium* and the other genera of Pythiaceae such as *Nematosporangium*, *Phytophthora*, *Pseudopythium*,<sup>3</sup> etc., cannot be made with any degree of accuracy. The same is true also of the different species of *Pythium*. The evolutionary tree of *Pythium* shows too much basal branching, that is, the various groups of interrelated species show that they have originated independently from some prototypic forms of which we have no representatives among our present collections. *Nematosporangium* and *Pythium* have doubtless sprung from the same bud, whereas, *Pseudopythium* and *Phytophthora* have probably sprung from some very elementary forms of *Pythium*. The arrangement of the different groups is in conformity with the degree of relationship of the different species. The tree is divided into two main branches, the one representing the species with ascomorphic antheridia and the other those with cylindrical to clavate antheridia, *P. complectens* being the most typical species of the former, and *P. Debaryanum* of the latter. These main branches are further subdivided into smaller branches representing the groups of species differentiated by either different types of oöspores, or different types of prosperangia. The different groups are as follows: (1) Those with smooth aplerotic oöspores, clavate antheridia and spherical to subspherical conidia;

<sup>3</sup> A new genus described in a paper following.

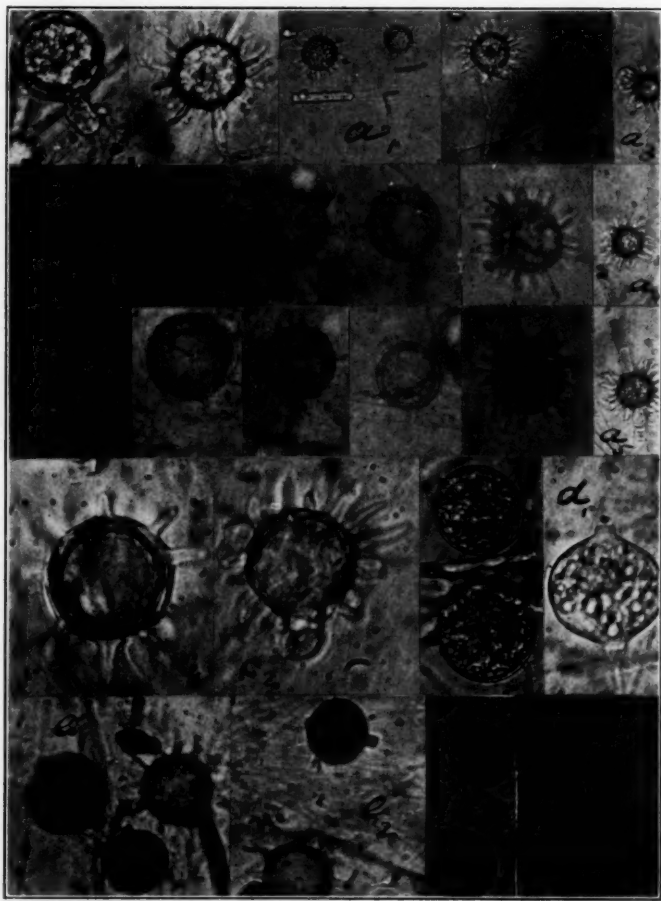


FIG. 18. *Pythium Artotrogus* var. *macracantha* Sideris: *a*<sub>1</sub>-*a*<sub>5</sub>, sexual organs ( $\times 300$ ); *b*, sexual organs ( $\times 150$ ); *c*<sub>1</sub>-*c*<sub>3</sub>, oöspores ( $\times 1000$ ); *d*<sub>1</sub>-*d*<sub>2</sub>, conidia ( $\times 1000$ ); *e*<sub>1</sub>-*e*<sub>3</sub>, conidia ( $\times 600$ ); unlabeled figures are oöspores ( $\times 600$ ); *f*, oöspore ( $\times 600$ ).—Note oögonial membrane surrounding spore not formed into spines.

(2) those with polymorphic aplerotic oöspores, clavate antheridia and spherical to subspherical conidia; (3) those with smooth aplerotic oöspores, clavate antheridia and spherical to subspherical

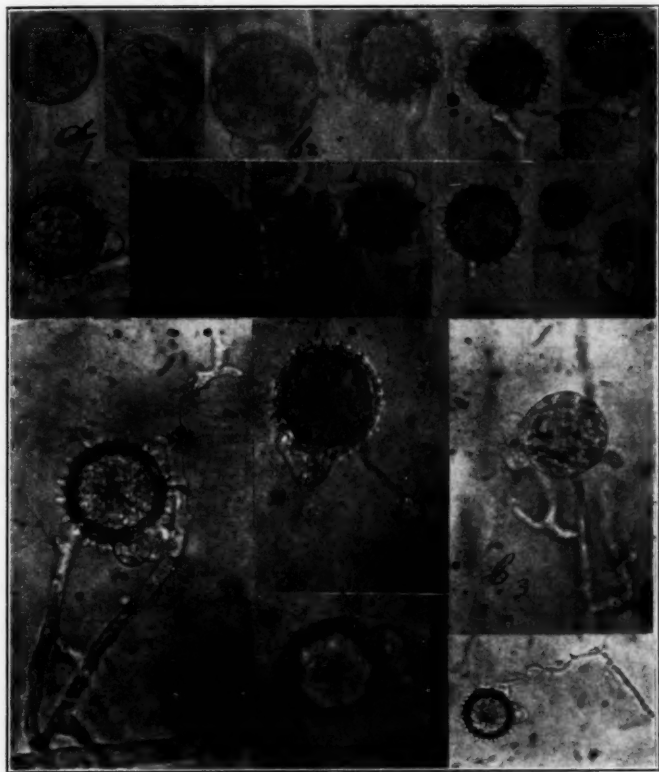


FIG. 19. *Pythium acanthophoron* Sideris: a, oögonium ( $\times 600$ ); b<sub>1</sub>-b<sub>5</sub>, sexual organs at the beginning of fertilization ( $\times 600$ ); unlabeled figures represent sexual organs and oöspores ( $\times 600$ ).—Note ascomorphic to allantoid antheridium.—Note ascomorphic antheridia.

conidia; (4) those with clavate antheridia and acanthophoric aplerotic oöspores; (5) those with ascomorphic antheridia, smooth aplerotic oöspores and spherical to subspherical conidia; (6) those with allantoid (ascomorphic) antheridia, acanthophoric aplerotic

oöspores and spherical to subspherical conidia, and (7) those with smooth aplerotic oöspores (antheridia not carefully studied), and lemon-shaped to subspherical conidia. Each group, although containing organisms having many characters in common, does not represent by any means, a very homogeneous assemblage. The groups or assemblages presented in this treatise constitute units of organisms having one or two morphological characters in common, and therefore approximately related. In figure 21 an attempt has been made to represent the phylogenetic relationship of the different species. The morphology of the conidia or prosporangia had to be considered besides that of the oöspores and antheridia in order that the different organisms be placed in as homogeneous groups of related species as possible. The citroform and subspherical form of the prosporangia of such species as *P. euthyhyphon* and *P. polycladon* shows slight resemblance to that of species of *Phytophthora*. The cultural characters and physiological behavior of *P. teratosporon* bear likewise close resemblance to those of *Pseudopythium*.

There are many such heterogeneous species, in the genus *Pythium*, indicating that our present species originated from ancestral clons with many morphological differences. The subdivision of *Pythium* into the tribes *Platyphalla* and *Stenophalla*, on the basis of the morphology of their antheridia, does away with some of the most confusing features of this genus. The morphology of the antheridium has in the past been given very little attention in the differentiation of species and still less in the segregation of groups of such species, probably, because its morphological differences are less prominent than those of some other organs. While the main subdivision on the basis of antheridium morphology is difficult to establish in mature material, it is usually very clear just prior to fertilization. The antheridia of *Platyphalla* show their ascomorphic shape more prominently before fertilization than after. Those of *Stenophalla* being usually clavate and narrow change very little, if any, before and after fertilization. The subdivision of the two tribes into the sections *Plerospora* and *Aplerospora* differentiates two distinct groups of organisms on the basis of the behavior of their oöspores in relation to the oögonium. The aplerotic type of oöspore occurs more often than the plerotic type.

The author's opinion is that the aplerotic type represents a more elementary form than the plerotic type. This assumption is made

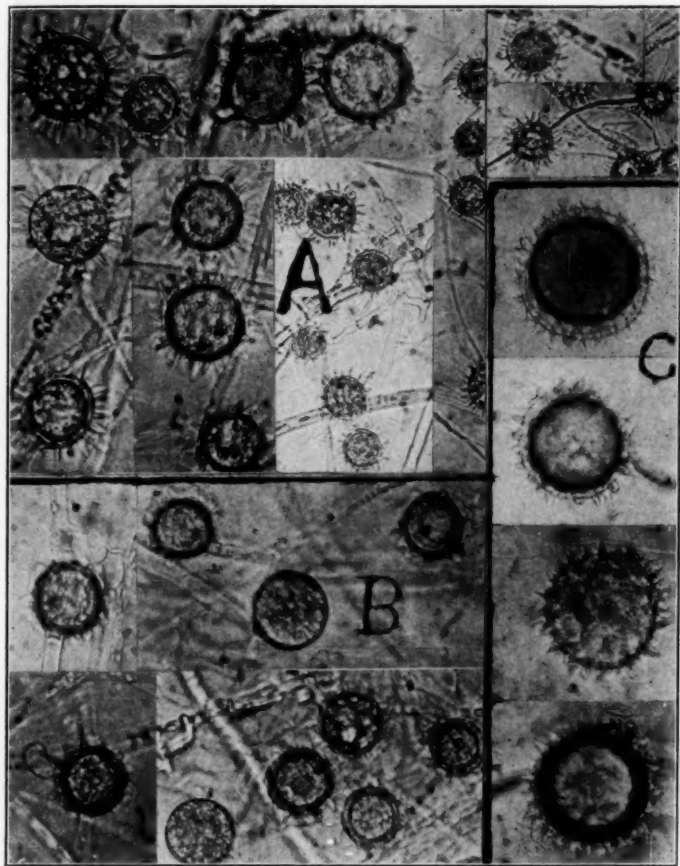
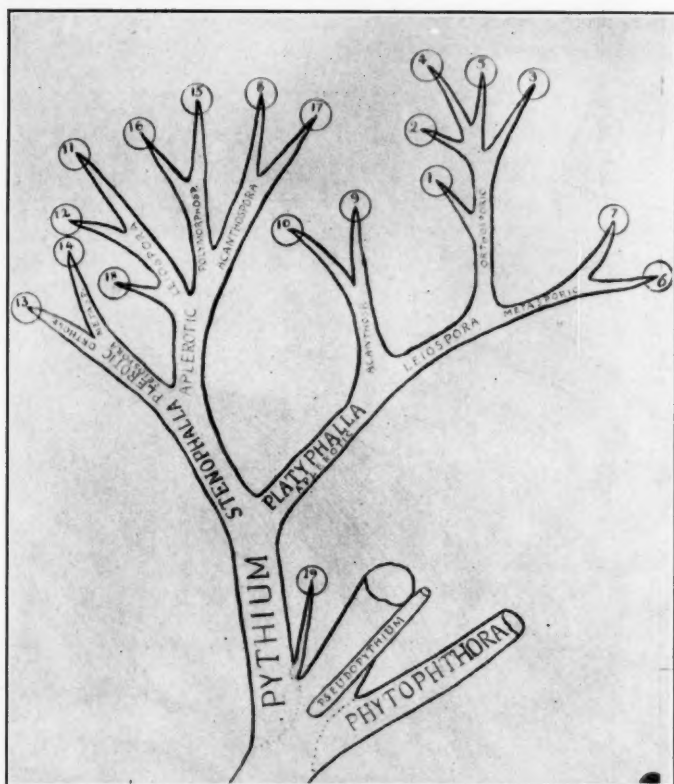


FIG. 20. (A) *Pythium Artotrogus* (Mont.) deBary: oöspores: large ( $\times 600$ ), small ( $\times 300$ ); (B) *Pythium mamillatum* Meurs: oöspores and oögonia ( $\times 600$ ); (C) *Pythium megalacanthum* deBary: oöspores and oögonium ( $\times 600$ ).

on the basis of the wider distribution of the aplerotic type of oöspores in the majority of species of the genus *Pythium* and those of the genera of the family Saprolegniaceae.

FIG. 21. Tree of the interspecific relationships of *Pythium*.

## PLATYPHALLA.

## APLEROSPORA. (Section)

*Leiospora*. (Subsection)

Metasporic	.....	<i>P. ascophallon</i> (7)
"	.....	<i>P. allantocladon</i> (6)
Orthosporic	.....	<i>P. complectens</i> (1)
"	.....	<i>P. polycladon</i> (4)
"	.....	<i>P. euthyhyphon</i> (5)
"	.....	<i>P. chamaihyphon</i> (2)
"	.....	<i>P. intermedium</i> (3)

*Acanthospora*. (Subsection)

Metasporic	.....	<i>P. acanthophoron</i> (9)
"	.....	<i>P. megalacanthum</i> (10)



The further subdivision of the above two sections into the subsections *Leiospora*, *Polymorphospora* and *Acanthospora* is based on the superficial morphology of the oöspores or rather the oögonial membrane surrounding such oöspores. The oögonial membrane surrounding the oöspores of the section *Aplerospora* may either retain its original smoothness or collapse and form either irregularly or regularly shaped wrinkles which develop in certain species into spines. In the section *Plerospora* such wrinkles or spines never occur. The various subsections could not be satisfactorily subdivided further into groups on the basis of the orthosporic or metasporic behavior of their prosperangia. Such classification could not be very reliable, because external conditions, such as chemical composition of the substratum and temperature, or internal conditions, such as age of the prosperangia may influence or inhibit the development of the one form of reproduction or the other. It has been found that different varieties of the same species may be either orthosporic or metasporic.

*Pythium intermedium* reproduces only asexually according to the findings of the writer and those of other investigators. Such a behavior has been acquired possibly in the long process of its evolution through the influence of environmental factors. It is doubtless related to *P. complectens* on the one hand and to *P.*

# STENOPHALLA.

## APLERSPORA. (Section)

### *Leiospora*. (Subsection)

Metasporic <sup>1</sup>	.....	<i>P. Debaryanum</i> (11)
"	.....	<i>P. araiosporon</i> (12)
"	.....	<i>P. splendens</i> (18)
"	.....	<i>P. teratosporon</i> (19)

### *Polymorphospora*. (Subsection)

Metasporic <sup>1</sup>	.....	<i>P. irregulare</i> (15)
"	.....	<i>P. polymorphon</i> (16)

### *Acanthospora*. (Subsection)

Metasporic <sup>1</sup>	.....	<i>P. mamillatum</i> (8)
"	.....	<i>P. Artotrogus</i> (17)

## PLERSPORA. (Section)

### *Leiospora*. (Subsection)

Orthosporic	.....	<i>P. diameson</i> (13)
Metasporic	.....	<i>P. plerosporon</i> (14)

<sup>1</sup> Mostly metasporic and very rarely orthosporic.

*chamaihyphon* on the other as the form of their conidia is practically identical and the production of oöspores in both organisms is always at the expense of their conidia or vice versa. It is likely that *P. intermedium* behaved in some similar manner until the process of conidia formation became the dominant process in its reproduction.

The total number of species with spiny oöspores cannot be grouped together for there are many morphological differences indicating the independent evolution of the two groups. The species with polymorphic and with spiny oöspores such as *P. polymorphon*, *P. irregulare*, *P. mamillatum* and *P. Artotrogus* have likely originated from closely related prototypes, whereas, those of *P. megalacanthum* and *P. acanthophoron* have originated from more distantly related prototypes. The former group is, likewise, more closely related to the group comprising *P. Debaryanum* and allied species and the latter to the group comprising *P. complectens* and allied species.

The conidia or prosperangia, in *Pythium* are recognized according to their form, as spherical, subspherical or ellipsoid, and lemon-shaped; position, as terminal and intercalary; and size, as small and large. There are two types of conidiophores or prosperangio-phores in *Pythium*, the simple or unbranched type possessed by most species and the branched type by few. *P. splendens* possesses branched as well as unbranched conidiophores with large mostly spherical conidia. *P. polycladon* and *P. chamaihyphon* possess branched as well as unbranched conidiophores with spherical to lemon-shaped or ellipsoid conidia. The shape of the conidia of the species included in *Stenophalla* are spherical to ellipsoid and in the greater number of species are smaller (except those of *P. splendens*) than those of the species of *Platyphalla*. The various groups as established give us a true picture of the morphological and possibly phylogenetic relationship of the species presented herewith. The morphological comparisons presented in this discussion, although philosophical to a certain extent, give us, nevertheless, a new angle from which to view the relationship of these different organisms.

The writer wishes to acknowledge his indebtedness to Dr. A. L. Dean and Dr. G. H. Godfrey for reading the manuscript and to

Mr. G. E. Paxton and Mrs. M. W. Lorimer for technical assistance.

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## NOTE

"*Pythium tetrasporon* (P. 40, Fig. 13) has been found through later studies of the writer to belong to *Phytophthora* and possibly in the group of organisms related to *Phytophthora cambivora*, and should be considered definitely a species of *Phytophthora*."

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## THE RUSTS OF SOUTH AMERICA BASED ON THE HOLWAY COLLECTIONS—VI<sup>1</sup>

H. S. JACKSON

### SPECIES ON VERBENACEAE

251. *AECIDIUM VERBENAE* Speg. Anal. Soc. Ci. Argent. 9: 174.  
1880.

*Aecidium verbenicola* Speg. Anal. Mus. Nac. Buenos Aires 19:  
323. 1909. (Not Ellis and Kellerm. 1884).

*Aecidium Spegazzinianum* Sacc. & Trott. Syll. Fung. 21: 775.  
1912.

*Aecidium elongatum* Speg. Rev. Argent. Bot. 1: 95. 1925.

*Aecidium verbeniphilum* Speg. Rev. Argent. Bot. 1: 102. 1925.

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*Verbena litoralis* H.B.K. Petropolis, Rio de Janeiro, Brazil,  
Nov. 3, 1921, 1272; Therezopolis, Rio de Janeiro, Oct. 1,  
1921, 1180; Friburgo, Rio de Janeiro, Brazil, Jan. 4,  
1922, 1454.

*Verbena* sp. Barbacena, Minas Geraes, Brazil, Dec. 12, 1922,  
1380; São Paulo, Brazil, Jan. 18, 1922, 1479.

There is some doubt whether or not all the names listed above belong to one species. Spegazzini evidently considered that there were at least two forms. His *A. Verbenae* he thought to be the aecial stage of *Puccinia elongata* Speg. The latter, however, seems, from the description, to be a short cycled form.

<sup>1</sup> Joint contribution from the Department of Botany, University of Toronto, and the Department of Botany, Purdue University Agricultural Experiment Station. Prepared in part (pp. 62-102) with the aid of a grant from the American Association for the Advancement of Science. The sixth of a series of papers bearing the same title. (See *Mycologia* 18: 139-163. 1926; 19: 51-65. 1927; 23: 96-116, 332-364, 463-503. 1931.) This number completes the series, and is published in full at this time through the aid of the E. W. D. HOLWAY HERBARIUM OF PLANT RUSTS fund, Botany Department, University of Minnesota. A supplementary number with indices is to be published at a later date. The Latin diagnoses in this number were prepared with the aid of Miss Margaret H. Thomson, M.A.

252. *AECIDIUM LANTANAE* Mayor, Mém. Soc. Neuch. Sci. Nat. 5: 567. 1913.

*Lantana lilacena* Desf. Petropolis, Rio de Janeiro, Brazil, Nov. 2, 1921, 1268; Bello Horizonte, Minas Geraes, Brazil, Dec. 1, 1921, 1353.

*Lantana rugulosa* H.B.K. Cuenca, Ecuador, Sept. 13, 1920, 985.

*Lantana* sp. Quito, Ecuador, Aug. 26, 1920, 947.

There may be some question whether this *Aecidium* differs from *A. Verbenae* Speg. It seems best to list it separately for the present. It appears to be reported previously only from Colombia, Nicaragua, and Panama.

253. *ENDOPHYLLUM STACHYTARPHETAE* (P. Henn.) Whetzel & Olive, Am. Jour. Bot. 4: 50. 1917.

*Aecidium Stachytarphetae* P. Henn. Hedwigia Beibl. 38: 71. 1899.

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*Stachytarpheta dichotoma* Vahl. Reserva Florestal, São Paulo, Brazil, May 6, 1922, 1808.

We follow the well established, though entirely illogical, custom of listing this collection as an *Endophyllum*. It should be recognized, because of the obvious origin of *Endophyllum* from *Aecidium*, that it is entirely possible that an *Aecidium* and the *Endophyllum* derived from it may both exist even in the same region. This species has been reported in South America from Brazil, Bolivia, Colombia and Trinidad. It is evidently common also in Porto Rico and Panama.

254. *PUCCINIA LANTANAE* Farl. Proc. Am. Acad. Sci. 18: 83. 1883.

*Uromyces Lantanae* Speg. Anal. Soc. Ci. Argent. 17: 93. 1884.

*Puccinia accedens* Sydow, Monog. Ured. 1: 309. 1902.

*Puccinia Privae* Sydow, Ann. Myc. 5: 338. 1907.

*Uromyces Lippiae* Speg. Anal. Mus. Nac. Buenos Aires 19: 313. 1909.

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*Lantana brasiliensis* Link, Bosque da Saude, São Paulo, Brazil, March 22, 1922, 1667.

*Lantana trifolia* L. São Paulo, Brazil, Jan. 20, 1922, 1483.

*Lippia rhodocnemis* Mart. & Schau. Rio de Janeiro, Brazil, Aug. 9, 1921, 1006.

*Lippia triflora* L. Hacienda Anacuri, Nor Yungas, Bolivia, June 4, 1920, 711.

This very common micro-form has a wide distribution extending from Florida and Mexico throughout the West Indies and less commonly in Central America. In South America it is reported from Colombia, Trinidad, Ecuador, Argentina and Brazil. Mesospores often predominate in the sori and the species may at first be mistaken for a *Uromyces*.

255. **Puccinia Mariae** Jackson, sp. nov.

II. Uredosoris hypophyllis, sparsis vel gregariis, rotundatis, 0.2–0.4 mm. diam., mox nudis, cinnamomeo-brunneis, pulverulentis, epidermide rupta inconspicuis; uredosporis obovoideis vel subgloboideis, 17–19  $\times$  19–22  $\mu$ ; tunica pallide cinnamomeo-brunnea, tenui, 1–1.5  $\mu$ , minute moderateque echinulata, poris 2 aequatorialibus praedita.

III. Teleutosoris uredosoris conformibus, brunneo-nigrescentibus; teleutosporis late ellipsoideis, 25–27  $\times$  30–38  $\mu$ , utrinque rotundatis, medio non vel moderate constrictis; tunica castaneo-brunnea, 2.5–3  $\mu$  cr., apice leniter incrassata, 3.5–4.5  $\mu$ , sparse verrucoso-echinulata, verrucis conoideis inter se 6–7  $\mu$  secernatis; poro loculi inferioris plerumque mediano; pedicello hyalino, fragili, sporam aequante vel plerumque brevior.

*Lippia* sp. Prata, São Paulo, Brazil, Apr. 9, 1922, 1719.

This species is very different from *P. senilis* Arth., in which the teliospore wall bears closely placed tuberculate-verrucose markings and has the apex considerably more thickened. We name the species in honor of Mrs. Mary M. Holway.

256. **PROSPODIUM LIPPIAE** (Speg.) Arth. N. Am. Fl. 7: 161. 1912.

*Puccinia Lippiae* Speg. Anal. Mus. Nac. Buenos Aires 6: 224. 1898.

*Uredo Lippiae* Speg. Anal. Mus. Nac. Buenos Aires 6: 238. 1898.

*Uredo Lippiae* Dietel & Holway; Holway, Bot. Gaz. 31: 335. 1901.

*Lippia hemisphaerica* Jacq. Guayaquil, Ecuador, Aug. 1, 1920, 807.

*Lippia ligustrina* (Lagerh.) Britton, Cochabamba, Bolivia, Feb. 26, 1920, 326, 327.

257. *PROSPODIUM TUBERCULATUM* (Speg.) Arth. N. Am. Fl. 7: 161. 1912.

*Uredo tuberculata* Speg. Anal. Soc. Ci. Argent. 9: 172. 1880.

*Puccinia tuberculata* Speg. Anal. Soc. Ci. Argent. 10: 6. 1880.

*Lantana Camara* L. La Paz, Bolivia, March 26, 1920, 465; Hacienda Anacuri, Nor Yungas, Bolivia, June 3, 1920, 706; São Bernardo, São Paulo, Brazil, Feb. 3, 1922, 1532; Campinas, São Paulo, Brazil, Apr. 2, 1922, 1688.

*Lantana mixta* L. Reserva Florestal, São Paulo, Brazil May 6, 1922, 1811.

All the collections listed above are of uredinia only, but seem to belong as assigned.

#### SPECIES ON LABIATAE

258. *PUCCINIA ANNULARIS* (Strauss) Schlecht. Fl. Berol. 2: 132. 1824.

*Uredo annularis* Strauss, Ann. Wett. Ges. 2: 106. 1810.

*Puccinia Teucrii* Biv.-Bern. Stirp. Rar. 3: 17. 1815.

*Teucrium bicolor* Smith, Temuco, Chile, Dec. 5, 1919, 200.

This common European and Asiatic micro-form seems not to have been previously reported from America. The collection listed above, however, appears to fit the description well.

259. *PUCCINIA GARDQUIAE* Dietel & Neger, in Engl. Bot. Jahrb. 22: 353. 1896.

*Gardoquia tomentosa* H.B.K. Riobamba, Ecuador, Aug. 11, 1920, 870.

This species has apparently been reported previously only from the type locality at Concepcion, Chile. While the collection listed above bears uredinia only, the spores agree well with the original description of this species.

260. PUCCINIA LEONOTIDIS (P. Henn.) Arth. Mycologia 7: 245. 1915.

*Uredo Leonotidis* P. Henn. in Engler, Pfl. Ost.-Afr. C: 52. 1895.

*Uredo leonoticola* P. Henn. Hedwigia, Beibl. 38: 69. 1899.

*Puccinia leonotidicola* P. Henn. in H. Baum, Kun.-Samb. Exp. 2: 157. 1903.

*Leonotis nepetaefolia* (L.) R. Br. Jardin Bot., Rio de Janeiro, Brazil, Aug. 11, 1921, 1020; Jundiahy, São Paulo, Brazil, Feb. 4, 1922, 1533.

The collections listed are of uredinia only as is the usual situation in this widely distributed tropical rust. The species is common throughout Central America and northern South America, and has been reported previously from Brazil and Argentina. It is also known in western Africa and eastern India.

261. PUCCINIA MENTHAE Pers. Syn. Fung. 227. 1801.

*Bystropogon mollis* H.B.K. Cochabamba, Bolivia, Feb. 26, 1920, 332; Sorata, Bolivia, Apr. 22, 1920, 562; Cuenca, Ecuador, Sept. 10, 1920, 968, 978.

*Bystropogon spicata* Benth. La Paz, Bolivia, May 13, 1920, 601, March 23, 1920, 448; Cuzco, Peru, July 2, 1920, 752; Hacienda del Urco, Urubamba Valley, Cuzco, Peru, July 4, 1920, 762-1/2.

These collections on *Bystropogon* are tentatively referred to this well known species. The teliospores average slightly larger and the wall markings are slightly more definitely echinulate than in most collections of *P. Menthae*.

262. PUCCINIA PALLIDISSIMA Speg. Anal. Soc. Ci. Argent. 12: 69. 1881.

*Puccinia albida* Dietel & Neger, in Engl. Bot. Jahrb. 24: 160. 1897.

*Stachys arvensis* L. Cochabamba, Bolivia, Feb. 25, 1920, 319.

*Stachys debilis* H.B.K. Quito, Ecuador, Aug. 15, 1920, 894.



*Stachys Macraei* Benth. Papudo, Chile, Sept. 19, 1919, 52;  
Zapallar, Chile, Feb. 1, 1920, 306.

Originally described from Argentina, this very distinct microform has also been reported from Brazil, Chile, Ecuador, Colombia and Venezuela. It is also known from Guatemala in Central America. Pycnia are lacking and the teliospores germinate with a two celled promycelium.

263. *Puccinia sphacelicola* Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis, gregariis, profunde insidentibus, rubro-brunneis, punctiformibus, irregulariter globoideis, 125–190  $\mu$  latis, 125–160  $\mu$  altis; periphysibus prominentibus.

I. Aecidiis hypophyllis vel costis suffultis, singulariter vel in greges 2–4 dispositis, magnis; peridio flavescenti, saccato, persistenti; cellulis peridialibus rhomboideis, leniter imbricatis, 18–25  $\times$  36–50  $\mu$ ; tunica interiore 1.5–2  $\mu$ , prominenter sed minute verrucosa, exteriore 3–5  $\mu$ , levi; aecidiosporis ellipsoideis vel globoideis, 25–30  $\times$  28–34  $\mu$ ; tunica 3–3.5  $\mu$  minute rugosa, reticulata.

III. Teleutosoris plerumque epiphyllis, sparsis vel gregariis, parvis, rotundatis, 0.3–0.5 mm. diam., castaneo-brunneis, mox nudis, pulverulentis; epidermide rupta aegre conspicua; teleutosporis late ellipsoideis, 25–29  $\times$  32–38  $\mu$ , utrinque rotundatis, septo non constrictis; tunica pallide castaneo-brunnea, 2.5–3.5  $\mu$  cr., apice incrassata 4–5  $\mu$ , minutissime crebreque verrucosa; pedicello hyalino, brevi, deciduo, saepe uno latere inserto.

*Sphacele paniculata* Benth. Riobamba, Ecuador, Aug. 10, 1920, 865 (type); Quito, Ecuador, Aug. 28, 1920, 937.

A characteristic -opsis form which seems to be distinct. The peridia are membranous, large and saccate, opening at the apex but not becoming fimbriate. The teliospore wall is slightly thickened over the pores and at the angles next the septum. The pore of the upper cell is apical. The pore in the lower cell is often in the centre with the pedicel attached at one side, or it is close to the pedicel on one side when the latter is attached at the centre of the base of the spore. The rugose-reticulate markings of the aeciospore will furnish a distinctive character.

SPECIES ON HYPTIS

264. *Puccinia amplifica* Jackson & Holway, sp. nov.

O. Pycnidiis non visis.

I. Aecidiis hypophyllis, in greges 1–6 dispositis, parvis, pro-

funde insidentibus, cupulatis; peridio inconspicuo, fragili, evanescenti; cellulis peridialibus laxè imbricatis prospectuque irregulariter polygoniis,  $15-18 \times 26-45 \mu$ ; tunicis tenuibus, mox collabescentibus; tunica interiore minute verrucosa; aecidiosporis ellipsoideis,  $14-16 \times 22-25 \mu$ ; tunica hyalina,  $1.5 \mu$ , crebre prominenterque verrucoso-tuberculata.

II. Uredosoris hypophyllis, sparsis, rotundatis, parvis  $0.2-0.3$  mm. diam., mox nudis, pulverulentis, pallide cinnamomeo-brunneis; epidermide rupta inconspicua; uredosporis globosis,  $18-22 \mu$  latis; tunica  $1.5 \mu$  cr., moderate minute verrucosa, poris 2 basalibus praedita.

III. Teleutosoris hypophyllis, sparsis, rotundatis,  $0.2-0.4$  mm., difformibus, aliis obscure castaneo-brunneis pulverulentisque, aliis pallide aurato-brunneis et compactis; teleutosporis difformibus, aliis conquiscentibus, late ellipsoideis,  $19-22 \times 27-33 \mu$ , utrinque rotundatis, septo leniter constrictis; tunica  $2-3 \mu$  cr. prominenter verrucosa, striis interdum longitudinalibus praedita; pedicello hyalino, brevi, deciduo; aliis germinantibus, ellipsoideis vel obovoideis,  $12-16 \times 26-30 \mu$ , supra rotundatis obtusisve, infra rotundatis angustatulisve; tunica hyalina,  $1 \mu$  cr. minusve, levi, septo non vel leniter constricta; pedicello hyalino, sporam aequante vel triplo superante.

*Hyptis eriocephala* Benth. Huigra, Prov. Chimborazo, Ecuador, Aug. 2, 1920, 811; Aug. 3, 1920, 817.

This interesting species differs from *P. Gibertii* Speng. in morphological characters but exhibits a similar habit. In both species teliospores of two distinct types are present. One kind has thin colorless, smooth walls and germinates at once while the other has thick, dark colored walls with definite markings and is evidently a resting spore. Both sorts may be found in the same sorus, though it is usual to find them in separate sori. In the two collections listed above No. 811 bears mainly thick walled teliospores while in No. 817 the thin walled spores predominate.

It is species of this sort that have lead the writer to the conviction that the genus *Eriosporangium* is not an acceptable one.

265. **Puccinia cavatica** Jackson & Holway, sp. nov.

O. Pycnidiis non visis.

I. Aecidiis amphigenis, plerumque costis suffultis vel cauliculis, fere singulariter dispositis, magnis,  $0.5-0.75$  mm. diam., lineamento orbicularibus vel ellipsoideis, bullatis, peridio aegre visibili praeditis; peridialibus (?) inter aecidiosporas cellulis, globosis,

27–30  $\mu$  diam.; tunica 1.5–3  $\mu$  cr., crebre verrucosa; aecidiosporis globosis vel ellipsoideis, 20–22  $\times$  20–24  $\mu$ ; tunica hyalina, 1.5–2  $\mu$ , crasse verrucosa.

III. Teleutosoris hypophyllis, sparsis, parvis, rotundatis, 0.2–0.4 mm. diam., mox nudis, compactis, pulvinatis, primum pallide cinnamomeo-brunneis, dein e germinatione cinereis; epidermide rupta non conspicua; teleutosporis, cylindraceis, fusoideis vel lanceolato-oblongis, 14–21  $\times$  54–75  $\mu$ , supra obtusis, infra plerumque attenuatis sed rotundatis; cellula superiore plerumque altera latiore, et fere fortiter constricta; tunica tenui 1  $\mu$  minusve, levi, pallide cinnamomeo-brunnea; pedicello hyalino, sporam aequante vel brevior.

*Hyptis carpinifolia* Benth. Bello Horizonte, Minas Geraes, Brazil, Nov. 22, 1921, 1325.

No urediniospores could be found and the species may be an -opsis form. The species does not agree with *P. Hyptidis*. It is possible that *Uredo Hammari* P. Henn., which Sydow (Monog. Ured. 4: 566, 1924) says is an aecidium, may be the same. No material has been available for comparison.

The aecia are characteristic, large and deep seated, and protected by a prominent over-arched growth of the epidermis.

266. PUCCINIA DISTORTA Holway, Ann. Myc. 3: 22. 1905.

*Hyptis* sp. (near *H. arborea* Benth.) Hacienda La Florida, Sur Yungas, Bolivia, May 26, 1920, 652.

This distinct micro-form is new to the South American flora having been previously reported only from the southern United States and Mexico.

267. PUCCINIA HYPTIDIS (M. A. Curtis) Tracy & Earle, Bull. Miss. Exp. Sta. 34: 86. 1895.

*Uredo Hyptidis* M. A. Curtis, Am. Jour. Sci. II. 6: 353. 1848.

*Eriosporangium Hyptidis* Arth. N. Am. Fl. 7: 211. 1912.

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*Hyptis canescens* Benth. Hacienda La Florida, Sur Yungas, Bolivia, May 26, 1920, 660; Villa Aspiazu, Sur Yungas, Bolivia, May 30, 1920, 683.

This species has been previously reported in South America from British Guiana, Trinidad and Colombia. A doubtful report by Dietel from Brazil may prove to be another species.

268. *PUCCINIA HYPTIDIS-MUTABILIS* Mayor, Mém. Soc. Neuch. Sci. Nat. 5: 496. 1913.

*Eriosporangium Hyptidis-mutabilis* Sydow, Ann. Myc. 20: 122. 1922.

*Hyptis dubia* Pohl. Reserva Florestal, São Paulo, Brazil, May 10, 1922, 1838.

*Hyptis pectinata* Poit. Petropolis, Rio de Janeiro, Brazil. Nov. 6, 1921, 1284; Petropolis, Rio de Janeiro, Brazil. Dec. 29, 1921, 1435.

*Hyptis suaveolens* (L.) Poit. Portovelo, Prov. del Oro, Ecuador, Sept. 22, 1920, 999; Campinas, São Paulo, Brazil, April 4, 1922, 1699.

*Hyptis umbrosa* Selzm. Friburgo, Rio de Janeiro, Brazil. Jan. 3, 1922, 1448.

*Hyptis* sp. Ouro Preto, Minas Geraes, Brazil, Dec. 6, 1921, 1368; Friburgo, Rio de Janeiro, Brazil, Jan. 4, 1922, 1455.

Originally described from Colombia, this species has been reported elsewhere in South America only from Trinidad. It is also known from Costa Rica.

269. *Puccinia perfuncta* Jackson & Holway, sp. nov.

O. Pycnidiis non visis.

I. Aecidiis plerumque epiphyllis, saepe costis suffultis et cauliculis, in gregibus 1-6 maculis decoloratis vel numerosioribus nervis caulibusve insidentibus, parvis, cupulatis, peridio aegre conspicuo fragili evanescenti praeditis; cellulis peridialibus laxè imbricatis; tunica intus extusque tenui, collabescente, interiore minute verrucosa; aecidiosporis parum irregulariter ellipsoideis,  $18-21 \times 24-30 \mu$ ; tunica hyalina,  $1.5-2 \mu$ , crasse tuberculata.

II. Uredosoris hypophyllis, sparsis, rotundatis  $0.2-0.4$  mm. diam., mox nudis, pulverulentis, aurato-brunneis; epidermide fissa non conspicua; uredosporis globosis,  $18-21 \mu$ ; tunica tenui, hyalina, vel leniter aurato-brunnescenti, minute crebreque verrucosa, poris obscuris praedita.

III. Teleutosoris hypophyllis, sparsis, rotundatis,  $0.2-0.4$  mm. diam., compactis, pulvinatis, primum flavescentibus, dein e germinatione cinereis; teleutosporis ellipsoideis,  $15-21 \times 30-36 \mu$ , supra rotundatis, infra rotundatis vel parum attenuatis, septo leniter constrictis; tunica uniformiter tenui,  $1-1.5 \mu$ , levi, pedicello hyalino brevi deciduo instructa.

*Hyptis fasciculata* Benth. Therezopolis, Rio de Janeiro, Brazil, October 11, 1921, 1211; Juquery, São Paulo, Brazil, Feb. 2, 1922, 1527 (type); Santa Amaro, São Paulo, Brazil, June 26, 1922, 1983.

*Hyptis pectinata* (L.) Poit. Huigra, Ecuador, Aug. 6, 1920, 849.

*Hyptis* sp. Petropolis, Rio de Janeiro, Brazil, Nov. 4, 1921, 1277.

While the teliospores resemble those of *P. medellinensis* Mayor, the urediniospores and aeciospores are quite different. The species is quite distinct from *P. tucumanensis* (Speg.) Arth., with which it has been compared.

The specimen on *Hyptis pectinata* is included here tentatively. The collection is fragmentary and consists of telia with a few urediniospores. The spores are somewhat larger than in *P. perfuncta*. It has been compared with *P. parilis* Arth., but does not agree well with that species. It may possibly be undescribed.

270. ***Puccinia perscita*** Jackson & Holway, sp. nov.

O. Pycnidii epiphyllis, profunde insidentibus, paucis, in maculis leniter hypertrophicis dense confertis, punctiformibus, ellipsoideis,  $90-120 \times 120-140 \mu$ , nigricantibus; periphysibus visibilibus.

I. Aecidiis epiphyllis, in greges parvos 3-6 aggregatis, purpur-ascentibus maculis circa pycnidia insidentibus, parvis, rotundatis, peridio visibili membranaceo saepe longo cylindraceo albo praeditis; cellulis peridialibus prospectu visis irregulariter polygoniis,  $18-21 \times 30-45 \mu$ ; tunica exteriore tenui  $1 \mu$  minusve, mox collabescente, levi, interiore  $3.5-5 \mu$  prominenter crebreque verrucoso-rugosa; aecidiosporis ellipsoideis,  $16-21 \times 25-31 \mu$ ; tunica hyalina,  $1.5-2 \mu$ , in extremo usque  $3-4.5 \mu$  incrassata, prominenter verrucosa, praesertim in extremo incrassato.

III. Teleutosoris hypophyllis, sparsis, rotundatis, parvis, 0.2-0.3 mm. diam., mox nudis, compactis, primum pallide castaneo-brunneis, deinde e germinatione cinereis; epidermide rupta inconspicua; teleutosporis ellipsoideis, oblongis vel obovatis,  $18-21 \times 44-56 \mu$ , supra rotundatis obtusisve, infra rotundatis angustatulisve, plerumque septo fortiter constrictis; tunica infra subhyalina, supra pallide castaneo-brunnea, tenui  $1 \mu$ , lateribus pori apiceque et poro loculi inferioris prope septum usque 2-2.5  $\mu$  paulatim incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Hyptis odorata* Benth. Hacienda La Florida, Sur Yungas, Bolivia, May 28, 1920, 669 (type); Villa Aspiazu, Sur Yungas, Bolivia, May 30, 1920, 684.

Apparently a distinct species, characterized by the small epiphyllous aecia with strongly developed peridium and the teliospores slightly thickened at the sides of the germ pores. It may possibly be an -opsis form as no uredinia were observed.

271. *Uredo amphiospora* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis vel gregariis, saepe confluentibus, rotundatis, 0.2–0.5 mm. diam., cinnamomeo- vel castaneo-brunneis, mox nudis, pulverulentis, epidermide rupta cinctis; uredosporis difformibus, aliis normalibus, depresso globosis, 17–19  $\mu$  altis, 21–24  $\mu$  latis, lateraliter visis, sed globosis extremo visis; tunica 1–1.5  $\mu$  cr., cinnamomeo-brunnea, crebre minuteque echinulata; poris 2, aequatorialibus, longo axe insidentibus; sed aliis amphiosporis (?), ellipsoideis vel oblongis, poris lateraliter visis, 21–26  $\times$  27–30  $\mu$ , tunica castaneo-brunnea, 3–4  $\mu$  cr., apparenter levi sed obscure echinulata, poris 2 aequatorialibus praedita.

*Hyptis spicata* Poit. Sorata, Bolivia, April 21, 1920, 560; Cochabamba, Bolivia, Feb. 25, 1920, 324 (type); March 5, 1920, 369.

This very distinct uredo-form has two very different types of spores which may occur in the same or separate sori. The thick walled spores may be interpreted as amphiospores. These are slightly compressed laterally, often appearing nearly globoid when pores are in face view. The normal urediniospores are flattened laterally and vertically, with the pores on the long axis and appear ellipsoid in side view and globoid in face view.

ON THE GENUS *SALVIA*

272. *Puccinia aenigmatica* Jackson & Holway, sp. nov.

II. Uredosoris amphigenis, sparsis, rotundatis, parvis, 0.2–0.4 mm. diam., mox nudis, pulverulentis, cinnamomeo-brunneis, epidermide rupta cinctis; uredosporis depresso globosis, 19–23  $\mu$  altis, 25–30  $\mu$  latis; tunica tenui, 1–1.5  $\mu$ , cinnamomeo-brunnea, crebre minuteque verrucosa, poris 2, hilo approximatis.

III. Teleutosoris amphigenis, rotundatis, 0.3–0.6 mm. diam., nigricantibus, compactis, dein pulverulentis, epidermide fissa

cinctis; teleutosporis globosis vel late ellipsoideis,  $31-35 \times 36-42 \mu$ , utrinque rotundatis, non constrictis; tunica castaneo-brunnea,  $4-6 \mu$  cr., apice incrassata ad  $6-9 \mu$ , crasse aequaliter verrucosa; pedicello hyalino, persistenti sed collabescente, sporam duplo vel triplo aequante.

*Salvia Kuntzeana* Briq. Cochabamba, Bolivia, March 1, 1920, 358.

Somewhat resembling *P. gentilis* Arth. and *P. porphyretica* Jackson & Holway. It differs from the former in the broader regular teliospores and the broader more finely marked urediniospores. From the latter it differs in the thin walled urediniospores which are depressed globoid.

273. *Puccinia albicera* Jackson & Holway, sp. nov.

*Puccinia aequatoriensis* Lagerh. ined. (not Sydow 1903).

O. Pycnidii epiphyllis, paucis, aecidiis immixtis, punctiformibus, primum brunneis deinde nigricantibus, profunde insidentibus,  $110-150 \mu$  latis,  $150-175 \mu$  altis; periphysibus brevibus.

I. Aecidiis epiphyllis, paucis, in greges 3-6 in areis leniter hypertrophicis aggregatis, cupulatis, peridio non prominenti praeditis, mox findendo unicellularibus, epidermide rupta cinctis; cellulis peridialibus, prospectu visis, irregulariter rhomboideis,  $24 \times 45 \mu$ ; tunica minutissime verrucosa sed apparenter levi; aecidiosporis angulato-ellipsoideis,  $18-24 \times 24-36 \mu$ ; tunica tenui,  $1-1.5 \mu$ , crasse verrucoso-tuberculata.

II. Uredosoris hypophyllis, sparsis vel gregariis, mox nudis, cinnamomeo-brunneis, pulverulentis; epidermide fissa inconspicua; uredosporis globosis,  $21-26 \mu$ ; tunica tenui  $1-1.5 \mu$ , cinnamomeo-brunnea, crebre minute echinulata; poris parum obscuris, 1-2, subaequatorialibus.

III. Teleutosoris hypophyllis, sparsis vel gregariis, primum pallide castaneo-brunneis, deinde e germinatione cinereis, pulvinatis; epidermide rupta non visibili; teleutosporis ellipsoideis, oblongis vel clavatis,  $16-19 \times 44-62 \mu$ , infra rotundatis attenuatisve, supra rotundatis obtusisve, plerumque septo prominenter constrictis; tunica cinnamomeo-brunnea, tenui  $1 \mu$  minusve, apice palliore area incrassata,  $35-36 \mu$ , levi; pedicello hyalino, sporam aequante vel brevior.

*Salvia derasa* Benth. Quito, Ecuador, Aug. 14, 1920, 889.

*Salvia tortuosa* H.B.K. Quito, Ecuador, Aug. 21, 1920, 930.

Very distinct from other eu-forms on *Salvia* on account of the thin smooth walled teliospores germinating at once.



274. *Puccinia stricta* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, prominentibus, paucis, in greges 2-6 aggregatis, maculis flavescentibus vel purpurascensibus insertis, profunde insidentibus, connoideis vel piriformibus, circiter  $125 \times 125 \mu$ .

III. Teleutosoris hypophyllis, pycnidiis gregatim contrappositis, cinnamomeo-brunneis, compactis, dein pulvinatis, e germinatione cinereis; epidermide rupta inconspicua; teleutosporis cylindraceis,  $22-28 \times 65-90 \mu$ , infra rotundatis vel truncatis, supra plerumque angustatulis, septo saepe prominenter constrictis; tunica tenui,  $1-1.5 \mu$ , apice non conspicue incrassata, levi; pedicello hyalino, forti, apice  $20-25 \mu$  lato, duplo vel triplo sporam aequante, mox collabescente.

*Salvia* sp. Huigra, Prov. Chimborazo, Ecuador, Aug. 4, 1920, 842A.

A very distinct micro-form, with large thin walled teliospores which germinate at once with a four celled promycelium. The apex of the teliospore is not thickened except very slightly at the sides of the pore. The pedicel is unusually thick and stout.

275. *PUCCINIA CONSPERSA* Dietel, Hedwigia 36: 30. 1897.

? *Puccinia uliginosa* Speg. Anal. Mus. Nac. Hist. Nat. Buenos Aires, 23: 26. 1912.

*Salvia arenaria* St. Hil. Campos do Jordão, São Paulo, Brazil, May 2, 1922, 1802.

*Salvia Sellowiana* Benth. Reserva Florestal, São Paulo, Brazil, May 16, 1922, 1806.

*Salvia splendens* Sellow, Sylvestre, Rio de Janeiro, Aug. 15, 1921, 1039.

*Salvia* sp. Rio de Janeiro, Brazil, Nov. 13, 1921, 1300; Petropolis, Rio de Janeiro, Nov. 8, 1921, 1285; São João, São Paulo, Brazil, July 2, 1922, 1993.

This species was described as having aecia and telia only. All our specimens show uredinia or urediniospores in the telia. *Puccinia uliginosa* Speg. was described with uredinia and later with aecia. Our material fits the measurements and description of both species very well, though no previous collections have been seen. *P. conspersa* was originally collected at Serra Geral,



Brazil. In some collections careful examination shows that the spores are minutely and very inconspicuously verrucose above.

276. *Puccinia conturbata* Jackson & Holway, sp. nov.

II. Uredosoris hypochyltis, sparsis vel gregariis, parvis, 0.2–0.4 mm. diam., mox nudis, cinnamomeo-brunneis, pulverulentis; epidermide rupta inconspicua; uredosporis globosis vel oblato-sphaeroideis, 22–25  $\mu$  diam., tunica 1.5–2  $\mu$  cinnamomeo-brunnea moderate minuteque echinulata praeditis; poris 2, subaequatorialibus.

III. Teleutosoris uredosoris conformibus, castaneo-brunneis; teleutosporis ellipsoideis vel oblongis, 23–26  $\times$  31–36  $\mu$ , utrinque rotundatis, septo leniter vel haud constrictis; tunica castaneo-brunnea, 1.5–2.5  $\mu$  cr., apice subcrasso praedita, 4–6  $\mu$ , prominenter verrucoso-rugosa; pedicello hyalino, brevi, deciduo.

*Salvia quitensis* Benth. Cuenca, Ecuador, Sept. 15, 1920, 992.

*Salvia* sp. Huigra, Prov. Chimborazo, Ecuador, Aug. 4, 1920, 842 (type).

This species differs from *P. infrequens* Holway in that the teliospore wall is thicker and the markings more prominent, and from *P. farenacea* Long in the character of the markings of the teliospores. The first specimen listed above is on a different host from the type and shows only urediniospores. These are small and have two subequatorial pores but may belong to a different species.

277. *Puccinia Gilliesi* Speg. Anal. Soc. Ci. Argent. 47: 265. 1899.

*Puccinia obesa* Sydow, Monog. Ured. 2: 298. 1902.

*Salvia Bangii* Rusby, Between Oruro and Cochabamba, Bolivia, Feb. 23, 1920, 314.

We follow Sydow (Monog. Ured. 2: 876. 1903) in listing *P. obesa* as a synonym of *P. Gilliesi*. The latter was described from teliospores only. The collection listed above bears uredinia and telia. The urediniospores agree well with Sydow's description, as do the teliospores except that they are slightly thickened over the pores. The pore of the lower cell is quite uniformly situated halfway between pedicel and septum. The teliospore wall is about 7.5  $\mu$  in thickness, thickened to 10  $\mu$  over the pores.

278. *PUCCINIA IMPEDITA* Mains & Holway; Arth. Mycologia 10: 135. 1918.

*Bullaria impedita* Arth. & Mains, N. Am. Fl. 7: 493. 1922.

*Salvia tiliaefolia* Vahl. Hacienda Anacuri, Nor Yungas, Bolivia, June 2, 1920, 700; Hacienda La Florida, Sur Yungas, Bolivia, May 29, 1920, 675.

The collections listed above are assigned to this brachy-form somewhat tentatively. The urediniospores are depressed globoid with two equatorial pores. The teliospores are somewhat lighter in color than specimens of this species which we have examined from Costa Rica. Pycnia were not seen. *P. impedita* is known in Central America and the West Indies. It has been reported on the above listed host from Mexico and Costa Rica. The only previous report from South America is from Trinidad.

279. *PUCCINIA MITRATA* Sydow, Monog. Ured. 2: 294. 1902.

*Salvia erythradena* Briq. Cochabamba, Bolivia, March 10, 1920, 386.

This species does not appear to have been previously listed from South America. It was originally described from Mexico and is also known from Guatemala. It is characterized by the large teliospores having conspicuously verrucose walls considerably thickened above, and by the rather small urediniospores.

280. *Puccinia porphyretica* Jackson & Holway, sp. nov.

II. Uredosoris amphigenis, plerumque epiphyllis, sparsis vel gregariis, in maculis flavescentibus subpurpureisve insidentibus, magnis, rotundatis, 1.0-1.75 mm. diam., cinnamomeo-brunneis, tardius nudis, pulverulentis, epidermide rupta cinctis; uredosporis late ellipsoideis vel obvoideis, 21-25  $\times$  25-28  $\mu$ ; tunica cinnamomeo-brunnea, 2.5-3  $\mu$  cr., moderate minuteque echinulata; poris 2, aequatorialibus.

III. Teleutosoris uredosoris conformibus, brunneo-nigricantibus, pulverulentis; teleutosporis globosis vel latissime ellipsoideis, 32-38  $\times$  36-44  $\mu$ , utrinque rotundatis, septo non constrictis; tunica castaneo-brunnea, 5-6  $\mu$  cr., apice incrassata ad 8-10  $\mu$ , prominenter aequaliterque verrucoso-rugosa; pedicello hyalino, rigido, in parte inserta 7-9  $\mu$  lato, infra angustato, duplo vel triplo sporam aequante.

*Salvia Cridgesii* Britton, Cochabamba, Bolivia, Feb. 26, 1920, 329.

*Salvia pseudoavicularis* Briq. Sorata, Bolivia, Apr. 15, 1920, 527.

*Salvia* sp. Hacienda del Urco, Urubamba Valley, Cuzco, Peru, July 4, 1920, 761 (type).

Collection 761, the last one listed, bears telia, the other two bear uredinia. The species is somewhat like *P. gentilis* Arth. from Mexico, but differs in several respects. The sori are much larger in our species and the urediniospore walls are thicker with the markings less prominent. The teliospores are broader, less irregular, and the markings more prominent with a greater tendency to be rugose.

281. *PUCCINIA ROESTELIIFORMIS* Lagerh.; Sydow, Monog. Ured. 2: 292. 1902.

*Salvia corrugata* Vahl. Biblian, Prov. de Cañar, Ecuador, Sept. 9, 1920, 966.

This very characteristic species has usually been considered an -opsis form. Our specimen, however, bears uredinia. These are abundant and accompanied by colorless, thin walled, clavate paraphyses up to  $125\ \mu$  long and with the apex  $16\text{--}26\ \mu$  broad. The urediniospores are very characteristic. They are globoid,  $25\text{--}29\ \mu$  in diameter. The wall is golden brown  $1\text{--}1.5\ \mu$  thick, finely verrucose, with about 8 scattered pores.

The wall of the aeciospore in this species is beautifully reticulate, a character which does not seem to have been noted.

282. *Puccinia sana* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, parvis, rotundatis,  $0.2\text{--}0.4$  mm. diam., mox nudis, cinnamomeo-brunneis, pulverulentis, epidermide rupea cinctis; uredosporis globosis,  $22\text{--}25\ \mu$  latis; tunica cinnamomeo-brunnea,  $1\text{--}1.5\ \mu$  cr., moderate minuteque echinulata, poro singulo laterali praedita.

III. Teleutosoris uredosoris conformibus, castaneo-brunneis, pulverulentis; teleutosporis late ellipsoideis, saepe parum irregularibus,  $21\text{--}25 \times 26\text{--}32\ \mu$ , utrinque rotundatis, plerumque non constrictis; tunica castaneo-brunnea,  $1.5\text{--}2\ \mu$  cr., apice et septo supra porum loculi inferioris ad  $3\text{--}4\ \mu$  leniter incrassata, minute crebreque verrucoso-rugosa; pedicello hyalino, brevi, fragili.

*Salvia leucocephala* H.B.K. Huigra, Chimborazo, Ecuador,  
Aug. 4, 1920, 835, 839.

A distinct species somewhat resembling *P. paramensis* Mayor but differing in the larger more prominently marked teliospores and in urediniospore characters. It is very much the same as an undescribed collection from Chimborazo, Ecuador, marked *P. andicola* Lagerh., which is in the New York Botanical Garden herbarium. A few aecia too old for description are present, indicating that the species is an eu-form.

#### SPECIES ON SOLANACEAE

283. ***Aecidium mundulum*** Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis vel cauliculis, per arias infectas dense dispersis, punctiformibus, aurato-brunneis, globosis vel ellipsoideis,  $120-125 \times 120-135 \mu$ ; periphysibus prominentibus,  $100 \mu$  vel longioribus.

I. Aecidiis hypophyllis vel cauliculis, ex mycelio late disperso aequaliter sparsis, cupulatis, peridio eroso non prominenti instructis; cellulis peridialibus rhomboideis, subforte imbricatis,  $11-13 \times 24-28 \mu$ ; pariete exteriori  $2-3 \mu$  cr., levi, interiore  $1-2 \mu$  cr., minute verrucoso; aecidiosporis ellipsoideis  $18-21 \times 25-31 \mu$ , tunica tenui  $1 \mu$  minute crebreque verrucosa praeditis.

*Solanum pulchellum* Phil. Zapallar, Chile, Sept. 22, 1919, 63.

284. ***Aecidium papudense*** Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis sed quandoque hypophyllis, in maculis flavescentibus dense confertis, punctiformibus, profunde indentibus, subflavis, globoideis,  $110-128 \mu$  latis; periphysibus prominentibus.

I. Aecidiis hypophyllis, in maculis flavescentibus aggregatis, magnis, cupulatis, bullatis, peridio subflavo eroso instructis; cellulis peridialibus laxae adhaerentibus, rhomboideis, parum imbricatis,  $13-19 \times 35-40 \mu$ ; pariete exteriori  $5-6 \mu$ , transverse striato, interiore  $1.5-2 \mu$ , minute verrucoso; aecidiosporis globosis vel ellipsoideis,  $21-25 \times 24-30 \mu$ ; tunica hyalina vel pallidissime aurato-brunnea,  $2 \mu$  cr., tenuiter verrucosa.

*Solanum runcinatum* R. & P. Papudo, Chile, Sept. 18, 1919, 38.

This aecidium differs notably from the preceding. The infection is local, producing spots. The aecia are somewhat

larger with more prominent peridium. The aeciospores, while about the same size, have much thicker walls.

285. **Aecidium Poecilochromae** Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis, in greges parvos crebre confertis, aecidiis circumdatis, punctiformibus, parvis, flavo-aureis, depresso globosis, 60–75  $\mu$  altis, 85–90  $\mu$  latis; periphysibus prominentibus.

I. Aecidiis hypophyllis, in greges 4–8 mm. diam. aggregatis, maculis flavescentibus insitis, saepe concentrice dispositis, peridio prominente erecto breviter cylindraceo praeditis; cellulis peridialibus rectangulis, leniter imbricatis, 17–20  $\times$  25–32  $\mu$ ; pariete exteriori 7–9  $\mu$  cr., transverse striato, interiore 2–3  $\mu$ , minute crebreque verrucoso; aecidiosporis globosis vel late ellipsoideis, 19–25  $\times$  25–32  $\mu$ ; tunica hyalina, 1–1.5  $\mu$ , minute crebreque verrucosa, apparenter prope tereti.

*Poecilochroma quitensis* Meirs.? Cochabamba, Bolivia, March 3, 1920, 363 (type), March 10, 1920, 388.

286. **Endophyllum Holwayi** Jackson, sp. nov.

O. Pycnidiis plerumque epiphyllis, quandoque amphigenis, crebre gregariis, gregatim teleutosoris contrappositis, subepidermicis, globosis vel oblato-sphaeroideis, 90–105  $\mu$  latis, 75–90  $\mu$  altis; periphysibus fasciculatis, prominentibus, 45–60  $\mu$  altis.

III. Teleutosoris aecidiiformibus, hypophyllis, crebre gregariis, in greges 1–4 mm. diam. dispositis, cupulatis; peridio visibili, firmo, albido, margine eroso vel revoluto instructo; cellulis peridialibus rhomboideis lateraliter visis, 9–13  $\times$  30–38  $\mu$ , leniter imbricatis; pariete exteriori, tereti, 3–4  $\mu$  cr., interiore 2–2.5  $\mu$ , minute crebreque verrucoso; soris teleutosporiferis castaneo-brunneis; teleutosporis catenulatis, parum irregulariter ellipsoideis vel oblongis, 16–21  $\times$  28–40  $\mu$ ; tunica cinnamomeo-usque castaneo-brunnea, 2.5–3.5  $\mu$  cr., apice saepe leniter crassiore, 4–4.5  $\mu$ , praecipue apice minute verrucosa, poro singulo visibili apicali praedita; basidio germinando 4-cellulari; basidiosporis ellipsoideis, 8–10  $\times$  12–16  $\mu$ .

*Salpichroa* sp. Sorata, Bolivia, Apr. 29, 1920, 582 (type); May 7, 1920, 592.

This remarkable rust is assigned tentatively to *Endophyllum*. While the gross appearance is that of an *Aecidium*, the spore mass is chestnut-brown. The remarkable feature of the species is the thick walled teliospores having a single apical pore. These spores appear like *Uromyces* spores without a pedicel. They are

borne in chains and intercalary cells may be demonstrated between the young spores though these are not conspicuous. There is some slight tendency to lateral adherence of the spores but no columns are formed which extend above the surface of the leaf. The spores occasionally collect in masses and when this is the case may be found germinating. The unopened sori appear very much like those of *Dietelia*.

287. *CHRYSOCYCLUS* CESTRI (Dietel & P. Henn.) Sydow, Ann. Myc. **23**: 322. Dec. 31, 1925.

*Puccinia Cestri* Dietel & P. Henn. Hedwigia **41**: 295. 1902.

*Chrysopsora Cestri* Arth. Bull. Torrey Club **51**: 53. 1924.

*Puccinia magnifica* Lagerh. ined.

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*Cestrum strigillatum* R. & P. Hacienda La Florida, Sur Yungas, Bolivia, May 26, 1920, 653.

*Cestrum* sp. Therezopolis, Estado do Rio, Brazil, Oct. 1, 1921, 1181; Reserva Florestal, Brazil, May 13, 1922, 1846; Tremembé, São Paulo, Brazil, May 30, 1922, 1907.

The first collection of this interesting species of which we have any knowledge was made by Lagerheim, June 1891, at Pichencha, Ecuador. This collection is marked *Puccinia magnifica* Lagerh., but the name seems never to have been published.

In 1924 Arthur transferred the species to *Chrysopsora*. During the year 1925, the writer made a study of this species together with *C. Mikaniae* Arth., and came to the conclusion that Arthur had misinterpreted their morphology. A preliminary note was published (*Mycologia* **18**: 48-49. Jan. 1, 1926) in which the genus *Holwayella* was proposed, with *C. Mikaniae* as the type, to accommodate these two species. Almost simultaneously, but technically one day previously, Sydow published the genus *Chrysocyclus* with the above species as the type.

The genus is in effect a micro-*Puccinia* in which the sori are waxy and there is no cessation of development between the formation of the spore initial and the time when the basidiospores are developed.

The type collection was made in Brazil and the species has been otherwise previously reported from Panama and Costa Rica.

288. DIDYMOPSIS SOLANI-ARGENTEI (P. Henn.) Dietel, Hedwigia  
38: 254. 1899.

*Aecidium Solani-argentei* P. Henn. Hedwigia 35: 260. 1896.

*Solanum Swartzianum* R. & S. Therezopolis, Rio de Janeiro,  
Brazil, Sept. 28, 1921, 1160.

*Solanum* sp. Tremembé, São Paulo, Brazil, May 30, 1922,  
1912.

This very characteristic species has been previously reported only from Brazil. Careful examination fails to reveal any evidence of a peridium. Each two celled spore is separated by a large, short, cylindrical intercalary cell, which may be 14–20  $\mu$  high by 16–18  $\mu$  wide. The spores germinate by a four-celled promycelium. The basidiospores are obovate, 9–12 by 14–16  $\mu$ .

289. PUCCINIA ACNISTI Arth. Bot. Gaz. 65: 470. 1918.

*Puccinia Nicotianae* Arth. Bot. Gaz. 65: 470. 1918.

*Acnistus* sp. El Chaco, Sur Yungas, Bolivia, May 25, 1920,  
651; Hacienda la Florida, Sur Yungas, Bolivia, May 27,  
1920, 667.

The two collections listed above bear aecia only and occur on different species of *Acnistus*. They seem to belong with this -opsis form, which was first described as on *Acnistus arborescens* Schlecht. from Santa Clara, Peru (Rose 18722a). The type host has since been identified as *A. aggregatus* (R. & P.) Miers. *Puccinia Nicotianae* was described at the same time as on *Nicotiana tomentosa* R. & P. This host has since been found to be *Acnistus aggregatus* also. The species is known from Trinidad and Costa Rica in the aecial stage.

290. PUCCINIA ARAUCANA Dietel & Neger, in Engl. Bot. Jahrb.  
24: 159. 1897.

*Solanum cyrtopodium* Dun. Recinto, Chile, Jan. 10, 1920, 284.

*Solanum lycioides* L. Cochabamba, Bolivia, March 7, 1920,  
378; LaPaz, Bolivia, March 19, 1920, 422.

*Solanum* sp. La Falda, Argentina, Aug. 24, 1922, 2049.

The first specimen listed above is on the same host species as

the type collection which was also made in Chile. The species, which appears to be an -opsis form, has not been previously reported elsewhere than in Chile. A collection made at Valdivia, Chile (Philippi No. 35) and reported by Winter as *P. pampeana* Speg. is probably the same.

291. ***Puccinia aulica*** Jackson & Holway, sp. nov.

O. Pycnidiis non visis, probaliter carentibus.

III. Teleutosoris hypophyllis caulicolisque, dense gregariis, aliis foliiculis in areas subhypertrophicas 1–2 mm. diam. confluentibus, sed aliis cauliculis latius dispositis, quandoque omnibus in contextibus novis dispositis, parvis, rotundatis, 0.2–0.5 mm. diam., mox nudis, pulvinatis, obscure castaneo-brunneis, epidermide rupta non visibili circumdatis; teleutosporis late ellipsoideis, 19–25 × 26–35  $\mu$ , utrinque rotundatis, non constrictis; tunica obscure cinnamomeo-brunnea, 1–1.5  $\mu$  cr., apice paulatim incrassata usque 5  $\mu$ , levi; pedicello hyalino, fragili, variabili, saepe deciduo, duplo ad triplum sporam aequante.

*Solanum montanum* L. Quito, Ecuador, Aug. 13, 1920, 875 (type).

292. ***Puccinia imitans*** Sydow, Monog. Ured. 1: 273. 1902.

*Solanum utile* Klotzsch, Quito, Ecuador, Aug. 19, 1920, 896.

This species was described from material collected by Lagerheim in the same locality from which the specimen listed above was obtained. The type collection is apparently the one reported as *P. Solani* Schw. by Patouillard and Lagerheim (Bull. Soc. Myc. Fr. 11: 215. 1915).

293. ***Puccinia negeriana*** Dietel, in Engl. Bot. Jahrb. 22: 351. 1896.

*Solanum* sp. La Falda, Argentina, Aug. 24, 1922, 2048.

The collection listed above appears to fit *P. negeriana* better than any of the other micro-forms described on *Solanum*. Mesospores are abundant. The species has presumably been reported only from Chile.

294. ***Puccinia sarachae*** Mayor, Mém. Soc. Neuch. Sci. Nat. 5: 499. 1913.

*Saracha biflora* R. & P. Sorata, Bolivia, Apr. 19, 1920, 554.



Originally described from Colombia, this micro-form has also been collected in Costa Rica.

295. PUCCINIA SOLANINA Speg. Anal. Mus. Nac. Hist. Nat. Buenos Aires 23: 26. 1912.

*Aecidium solaninum* Speg. Anal. Soc. Ci. Argent. 12: 79. 1881.

*Aecidium solaninum* var. *laevis* Speg. Anal. Mus. Nac. Hist. Nat. Buenos Aires 19: 322. 1909.

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*Acnistus* sp. Huigra, Prov. Chimborazo, Ecuador, Aug. 8, 1920, 858.

This collection consists of aecia and associated telia and is evidently an -opsis form. The aecia are systemic. The teliospores are described as smooth, but are minutely verrucose. Otherwise the material fits the description admirably.

296. PUCCINIA SOLANI-TRISTIS P. Henn. Hedwigia 35: 236. 1896.

*Solanum Neves-Armondii* Dusén, Reserva Florestal, Itatiaya, Brazil, May 7, 1922, 1820.

*Solanum rufescens* Sendt. Therezopolis, Rio de Janeiro, Brazil, Oct. 9, 1921, 1205.

*Solanum* sp. Therezopolis, Rio de Janeiro, Brazil, Oct. 9, 1921, 1203; Petropolis, Rio de Janeiro, Brazil, Oct. 18, 1921, 1231; Campinas, São Paulo, Brazil, Apr. 2, 1922, 1686; Reserva Florestal, Itatiaya, Brazil, May 9, 1922, 1835.

297. PUCCINIA TUBULOSA (Pat. & Gaill.) Arth. Am. Jour. Bot. 5: 464. 1918.

*Aecidium tubulosum* Pat. & Gaill. Bull. Soc. Myc. France 4: 97. 1888.

*Aecidium Uleanum* Paz. Hedwigia 31: 95. 1892.

*Aecidium solanophilum* Speg. Ann. Mus. Nac. Buenos Aires 23: 34. 1912.

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*Solanum subscandens* Vell. São Paulo, Brazil, Jan. 23, 1922, 1495.

*Solanum torvum* Sw. Ribeirão Pires, São Paulo, Brazil, March 25, 1922, 1680.

*Solanum* sp. Barbacena, Minas Geraes, Brazil, Dec. 13, 1921, 1391; São João, São Paulo, Brazil, Apr. 13, 1922, 1728; Villa Prudente, São Paulo, Brazil, May 31, 1922, 1922.

This heteroecious species with uredinia and telia on *Paspalum* and other grasses is listed here to make the record of solanaceous rusts complete. The species is considered in detail by Arthur in his report on the grass rusts of the Holway collections (Proc. Am. Phil. Soc. 64: 173-176. 1925).

298. ***Puccinosira Holwayi* Jackson, sp. nov.**

O. Pycnidiis epiphyllis, numerosis, punctiformibus, profunde insidentibus, crebre gregariis, in maculis decoloratis positus, globosis vel depresso globosis, 90-150  $\mu$  altis, 120-150  $\mu$  latis; periphysibus carentibus.

III. Teleutosoris hypophyllis, numerosis, in greges orbiculares 1.5-4 mm. diam. insidentibus, breviter cylindraceis; peridio membranaceo, columnae sporarum firme adhaerente; teleutosporis bicellularibus, parum irregulariter ellipsoideis, 16-24  $\times$  36-48  $\mu$ , apice saepe acuto instructis, septo, saepe obliquo, non constrictis; tunica e hyalina flavescenti, plerumque uniformiter tenui, 1-1.5  $\mu$ , sed quandoque una vel utraque fine incrassata usque 5  $\mu$ ; cellulis intercalaribus conspicuis.

*Solanum laxiflorum* Sendt. Petropolis, Rio de Janeiro, Brazil, Dec. 29, 1921, 1434.

The species is somewhat like *P. Solani* Lagerh. but differs primarily in that the teliospore wall is only slightly or not at all thickened. When the wall is thicker, the thickened portion is confined to opposite ends of the two-celled spore. In *P. Solani* the thickening is much greater and occurs at the apex of both cells of the two-celled spores.

299. **UROMYCES CESTRI** (Mont.) Lév. Ann. Sci. Nat. III. 8: 371. 1847.

*Aecidium Cestri* Mont. Ann. Sci. Nat. II. 3: 356. 1835.

*Uredo Cestri* Bert.; Mont. Ann. Sci. Nat. II. 3: 356. 1835.

*Pucciniola Cestri* Arth. N. Am. Fl. 7: 452. 1921.

*Cestrum auriculatum* L'Hér. Sorata, Bolivia, Apr. 14, 1920, 524; Cochabamba, Bolivia, Feb. 25, 1920, 317.

*Cestrum Parqui* L'Hér. Panimavida, Chile, Dec. 10, 1919, 217; Viña del Mar, Chile, Sept. 4, 1919, 1; Baños de Conquenes, via Roncaqua, Chile, Jan. 13, 1920, 292.

*Cestrum Schlechtendalii* Don. Tremembé, São Paulo, Brazil, May 30, 1922, 1913.

*Cestrum strigillatum* R. & P. Quito, Ecuador, Aug. 18, 1920, 911.

*Cestrum undulatum* R. & P. Choisica, Peru, July 22, 1920, 779.

*Cestrum* sp. Zapallar, Chile, Jan. 31, 1920, 302; Cochabamba, Bolivia, March 11, 1920, 395; Therezopolis, Rio de Janeiro, Brazil, Oct. 6, 1921, 1194; Paulista Park, São Paulo, Brazil, Apr. 15, 1922, 1733; La Falda, Argentina, Aug. 16, 1922, 2032.

Originally described from Juan Fernandez, Chile, this species has been previously reported in various sections of South America and is also common in Central America and the West Indies.

300. *UROMYCES MACULANS* (Pat.) Arth. Mycologia 10: 124. 1918.

*Uromyces Cestri maculans* Pat. Bull. Soc. Myc. Fr. 28: 140. 1912.

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*Cestrum calycinum* Willd. Sorata, Bolivia, Apr. 29, 1920, 584.

The specimen listed above bears aecia only and is assigned to *U. maculans* with considerable confidence. The species has not previously been reported for South America. It was originally described from Costa Rica and is also known in Guatemala and Salvador.

301. *Uromyces Salpichroae* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, rotundatis, 0.3–0.5 mm. diam., mox nudis, aurato-brunneis, pulverulentis, epidermide rupta cinctis; uredosporis ellipsoideis vel obovatis, 17–21  $\times$  23–28  $\mu$ ; tunica hyalina vel pallide aurato-brunnea, 1–1.5  $\mu$  cr., crebre minuteque echinulata; poris obscuris, 2 vel 3, superaequatorialibus.

III. Teleutosoris uredosoris conformibus, compactis, pulvinatis, pallide castaneo-brunneis, ob germinationem cinerascens; teleutosporis obovatis, 13–19  $\times$  25–38  $\mu$ , supra obtusis,

infra plerumque attenuatis; tunica hyalina vel parum cinnamomeo-brunnescenti, tenui,  $1\ \mu$  minusve, apice crassiore  $4\text{--}7.5\ \mu$ , levi; pedicello hyalino, sporam aequante vel brevior.

*Salpichroa diffusa* Miers. Cuenca, Ecuador, Sept. 10, 1920, 976.

*Salpichroa* sp. Sorata, Bolivia, May 1, 1920, 585 (type).

#### SPECIES ON SCROPHULARIACEAE

302. *CRONARTIUM COLEOSPORIOIDES* (Dietel & Holway) Arth. N. Am. Fl. 7: 123. 1907.

*Uredo coleosporioides* Dietel & Holway, Erythea 1: 247. 1893.

*Castilleja* sp. Quito, Ecuador, Aug. 21, 1920, 934.

The collection bears uredinia only and the urediniospores agree well with this species which seems not to have been previously reported from South America.

#### SPECIES ON BIGNONIACEAE

303. *Cerotelium Holwayi* Jackson, sp. nov.

II. Uredosoris hypophyllis, sparsis, numerosis, parvis,  $0.2\text{--}0.3$  mm. diam., cinnamomeo- vel castaneo-brunneis, pulverulentis, copiosis incurvatis paraphysibus circumdatis; paraphysibus numerosis, rectis vel saepius curvatis, apparenter compacta parte ad basim conjunctis,  $6\text{--}15 \times 35\text{--}60\ \mu$ ; tunica irregulariter, saepe magnopere, extus incrassata, hyalina usque castaneo-brunnescenti, apice acuta saepeque acuminata,  $2\text{--}4$  septata; uredosporis obovoideis,  $16\text{--}19 \times 21\text{--}28\ \mu$ ; tunica hyalina vel leniter tincta,  $1\ \mu$  cr., quandoque leniter incrassata usque  $2.5\ \mu$ , minutissime creberrimeque echinulata, poris obscuris praedita.

III. Teleutosoris hypophyllis, minutis, erumpentibus, columnaribus; teleutosporis catenulatis, recte transverseque adhaerentibus itaque columnas  $100\text{--}130 \times 100\text{--}165\ \mu$  altas efficientibus, breviter cylindraceis,  $12\text{--}15 \times 15\text{--}18\ \mu$ ; tunica hyalina vel leniter tincta, tenui  $1\ \mu$  minusve, levi.

*Bignoniaceae* (unidentified)

Jacarépaquá, Rio de Janeiro, Brazil, Nov. 16, 1921, 1315 (type); Mogy das Cruces, Brazil, July 4, 1922, 2001; San Francisco, Nictheroy, Rio de Janeiro, Brazil, Sept. 23, 1921, 1142; Pindamonhangaba, São Paulo, Brazil, May 4, 1922, 1812.

All the collections listed above are on different hosts. Only the first one, selected as the type, bears teliospores, the others bear uredinia only. There is some variation in the different collections and it is possible that more than one species is represented. We have not been able to determine whether any of the species of unconnected *Uredo* which have been described belong here. A specimen marked *Uredo luteola* Speg. on *Pyrostegia venusta* from Paraguay is similar in microscopic characters, but the gross appearance of the sori is quite different. We have been unable to locate a description of this species.

304. *PROSPODIUM AMPHILOPHII* (Dietel & Holway) Arth. Jour. Myc. **13**: 31. 1907.

*Puccinia Amphilophii* Dietel & Holway, Bot. Gaz. **24**: 30. 1897.

*Puccinia phlyctopus* Sydow, Monog. Ured. **1**: 242. 1902.

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*Pithecoctenium* sp. Sylvestre, Rio de Janeiro, Brazil, Aug. 15, 1921, 1040; Nictheroy, Rio de Janeiro, Brazil, Aug. 18, 1921, 1049; Lapa, São Paulo, Brazil, June 4, 1922, 1938; Taipas, São Paulo, Brazil, June 10, 1922, 1947; Curityba, Paraná, Brazil, June 20, 1922, 1978.

I have assigned tentatively to this species a group of collections, bearing small urediniospores the outer wall of which does not swell in water, and in which the teliospores are noticeably constricted with little evidence of an outer wall. The pedicels are long and usually unadorned.

305. *Prospodium anomalum* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, tarde nudis, obscure cinnamomeo-brunneis, pulverulentis, cuticula rupta conspicue cinctis; uredosporis parum irregulariter globoideis vel ellipsoideis, 20–25  $\mu$  diam. (tunica exteriori exclusa); tunica laminata, interiori cinnamomeo-brunnea, 2–3  $\mu$  cr., exteriori hyalina, usque 4  $\mu$  cr. inflata itaque annulum latum ramosum efformante, crebre minute verrucoso-echinulata; poris 2, aequatorialibus.

III. Teleutosoris uredosoris conformibus; teleutosporis late ellipsoideis, 27–30  $\times$  38–45  $\mu$ , utrinque rotundatis, non vel vix constrictis; tunica theobromina, 4–6  $\mu$  cr., poris lentissime incrassata, exteriori inconspicua, sparsius verrucosa, papillis

humilibus instructa; pedicello hyalino vel leniter tincta, inornato vel leniter disperseque appendiculato.

*Bignoniaceae* (unidentified) Mogy das Cruces, São Paulo, Brazil, July 4, 1922, 1997.

A species with rather large, dark teliospores and with sorus characters quite different from most species of *Prospodium*. The most characteristic difference, however, is in the urediniospores. In the latter, the outer wall seems to gelatinize in the form of a broad band. This band, which in most similar species is a single one running around the spore, in this species seems to fork on either side so that there are two broad bands at the apex of the spore. When seen in side view, the bands show as three points, two above and one at the base giving a triangular appearance to the spore outline. When seen in face view, there appears to be a complete, evenly thickened outer wall. The markings which appear to be confined to the bands, are close and of the verrucose type. No paraphyses were observed.

306. *PROSPODIUM APPENDICULATUM* (Wint.) Arth. Jour. Myc. 13: 31. 1907.

*Puccinia appendiculata* Wint. Flora 67: 262. 1884.

*Puccinia ornata* Hark. Proc. Calif., Acad. Sci., II, 2: 231. 1889.

*Puccinia medusaeoides* Arth. Bot. Gaz. 16: 226. 1891.

*Uredo cuticulosa* Ellis & Ev. Bull. Lab. Nat. Hist. Iowa. 4: 67. 1896.

*Puccinia cuticulosa* Arth. Mycologia 9: 83. 1917.

*Puccinia Tecomae* Sacc. & Sydow in Sacc. Syll. Fung. 14: 358. 1899.

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*Stenolobium Gaudichaudi* DC. Guayaquil, Ecuador, Aug. 1, 1920, 806.

*Stenolobium* sp. Hacienda del Urco, Urubamba Valley, Cuzco, Peru, July 4, 1920, 760; Huigra, Chimborazo, Ecuador, Aug. 5, 1920, 846.

Lagerheim collected this species in the same locality and on the same host as the collection first reported above. Otherwise the species has previously been reported from South America

only from Trinidad on *Stenolobium Stans*. The species is common in Central America and the West Indies on the last mentioned host and is known also from Mexico and Guatemala on *S. molle*.

307. **Prospodium Arrabidaee** Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis caulicolisque, subcuticularibus, crebre in greges parvos aggregatis, punctiformibus, conspicuis, obscure brunneis, hemisphaericis, vel connoideis, 45–60  $\mu$  altis, 90–120  $\mu$  latis; interdum periphysibus fasciculum 30  $\mu$  altum efformantibus.

III. Teleutosoris amphigenis vel caulicolis, subcuticularibus, obscure cinnamomeo-brunneis, soris foliicolis magnis confluentibus circa pycnidia circinantibus sed caulicolis elongatis areas obsoletas occupantibus praeditis, tardius nudis, pulverulentis, cuticula fissa plerumque cinctis; teleutosporis late ellipsoideis, magnitudine variabilibus, 18–27  $\times$  24–33  $\mu$ , utrinque rotundatis, leniter vel non constrictis; tunica obscure cinnamomeo-vel pallide castaneo-brunnea, 3–4  $\mu$  cr., exteriore hyalina, conspicua, moderate minuteque verrucosa; pedicello hyalino vel leniter tincta, brevi, deciduo.

*Arrabidaea* sp. (near *A. Blanchetii* DC.) Bello Horizonte, Minas Geraes, Brazil, Dec. 1, 1921, 1354.

It is with some hesitation that this microcyclic species and the one on *Cremastus* are described as distinct. It would appear, however, that there are a number of microcyclic species occurring on different host genera in the Bignoniaceae which may become systemic and cause witches brooms. These species are all much alike and possibly when better known should be assigned to one variable species. We hesitate, however, to assign them to *P. elegans* Schröt. though they appear to be similar.

308. **Prospodium Cremastum** Jackson & Holway, sp. nov.

O. Pycnidiis non visis.

III. Teleutosoris amphigenis caulicolisque, ubique in ramis junioribus deformatis dense dispositis, confluentibus, indefinitis, pulverulentis, obscure cinnamomeo-brunneis; cuticula rupta plerumque aegre visibili; teleutosporis ellipsoideis, 21–24  $\times$  27–30  $\mu$ , utrinque rotundatis, non vel leniter septo constrictis; pariete interiore pallide castaneo-brunneo, 1.5–2  $\mu$  cr., exteriore in aqua inflato, fere hyalino, 2–2.5  $\mu$  cr., minute crebreque verrucoso; papillis saepe coalescentibus; pedicello infra angustato, sporam aequante vel brevior.

*Cremastus sceptrum* Bur. & Schum. Bello Horizonte, Minas Geraes, Brazil, Nov. 24, 1921, 1331.

A microcyclic species which causes abundant distortion of the young shoots. Perhaps too close to *P. Arrabidaeae* and *P. elegans*. (See discussion under former species.)

309. **Prospodium Holwayi** Jackson, sp. nov.

II. Uredosoris hypophyllis, sparsis, rotundatis, parvis, 0.1–0.3 mm. diam., tardius nudis, pulverulentis, cinnamomeo-brunneis, cuticula rupta cinctis; uredosporis subgloboideis vel obovoideis,  $18-21 \times 22-26 \mu$ ; tunica pallide cinnamomeo-brunnea,  $1-1.5 \mu$ , moderate maximeque inconspicue verrucosa, poris 2 aequatorialibus praedita.

III. Teleutosoris uredosoris conformibus, castaneo-brunneis, pulverulentis; teleutosporis parum irregulariter ellipsoideis,  $22-25 \times 32-35 \mu$ , utrinque rotundatis, conspicue constrictis; tunica castaneo-brunnea, non laminata, tenui,  $1.5-2 \mu$ , supra poros non vel lentissime incrassata, apparenter tereti sed vere maxime inconspicue verrucosa; pedicello brevi, deciduo, in parte inserta lato, saepe lateraliter inserto, inornato.

*Pithecoctenium* ? sp. Taipas, São Paulo, Brazil, Feb. 7, 1922, 1541 (type); June 10, 1922, 1956.

This species is distinguished by the nearly smooth teliospores without evident outer layer and by the thin walled, unlaminated urediniospores.

310. **Prospodium impolitum** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis vel gregariis, rotundatis, 0.2–0.4 mm. diam., obscure cinnamomeo-brunneis; cuticula rupta non visibili; paraphysibus copiosis, incurvatis,  $6-12 \times 45-90 \mu$ , apice acuminatis, sorum circumdantibus, basi apparenter conjunctis; tunica ex hyalina castaneo-brunnea, extus irregulariter incrassata, intus tenui; uredosporis lateraliter depressis, poris e facie visis, globosis,  $24-30 \mu$  diam., sed, e latere, ellipsoideis,  $19-24 \times 24-30 \mu$ ; pariete interiore pallide castaneo-brunneo,  $2-2.5 \mu$  cr., exteriore hyalino, aqua inflato, sparse echinato; poris 2, aequatorialibus.

III. Teleutosoris uredosoris conformibus, obscure castaneo-brunneis, pulverulentis; paraphysibus uredosoris conformibus; teleutosporis late ellipsoideis,  $26-30 \times 36-42 \mu$ , utrinque rotundatis, septo non constrictis; tunica castaneo-brunnea,  $3-4 \mu$  cr., lamina exteriore non conspicua praedita, leniter tincta, apice



incrassata usque  $6\mu$ , valde sparseque verrucoso-echinulata, conspicue conice papillata; pedicello hyalino vel prope sporam leniter tincta, sporam aequante vel subdimidio longiore, inornato vel infra singulo orbi appendiculato.

*Haplophium bracteatum* Cham. Campinas, São Paulo, Brazil, Apr. 3, 1922, 1691.

*Pyrostegia venusta* (Vell.) Presl. Juquery, São Paulo, Brazil, June 12, 1922, 1958 (type).

*Stizophyllus* sp. ? Anvim, São Paulo, Brazil, March 15, 1922, 1634.

*Tynnanthus* sp. Juquery, São Paulo, Brazil, Feb. 2, 1922, 1531.

*Bignoniaceae* unidentified. Juquery, São Paulo, Brazil, Feb. 2, 1922, 1530; São Roque, São Paulo, Brazil, March 21, 1922, 1665; Lapa, São Paulo, Brazil, March 24, 1922, 1674, June 3, 1922, 1936; São João, São Paulo, Brazil, July 2, 1922, 1996.

The description has been drawn largely from the second collection listed above, which has been selected as the type. Collections having the sori surrounded by conspicuous dark incurved paraphyses and with large urediniospores with conspicuous outer layer swelling in water, and with strongly marked teliospores, are included here. The outer wall of the urediniospore in this and other species having similar characteristics seems to be thickened in a broad band extending around the spore. It is visible as a colorless, thick halo when the spores lie in face view. When the spores lie on edge, that is, with pores in optical section, the band is conspicuous only at either end of the spore.

311. ***Prospodium Lundiae*** Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis, subcuticularibus, paucis in omni grege collectis, maculis decoloratis insidentibus, punctiformibus, brunneolis, humiliter hemisphaericis,  $65-75 \times 135-160\mu$ ; periphysibus praesentibus, quandoque extrusis.

III. Teleutosoris amphigenis vel saepius hypophyllis, magnis, confluentibus, circa sorum pycnidiorum circulum efformantibus, 1-2.5 mm. latis, tardius nudis, pallide castaneo-brunneis, pulverulentis, cuticula rupta conspicue cinctis; uredosporis in teleutosoris sitis globosis vel interdum ellipsoideis,  $24-32\mu$  diam.; pariete interiore castaneo-brunneo,  $2.5-3\mu$  cr., exteriori

hyalino, magnopere inflato,  $3-4\ \mu$  cr., sparse echinulato; poris 2 aequatorialibus; paraphysibus paucis, per sorum dispersis, hyalinis, rectis, tunicis crassis instructis,  $5-7 \times 45-60\ \mu$ , teleutosporis late ellipsoideis,  $24-30 \times 36-42\ \mu$ , utrinque rotundatis, non constrictis; tunica castaneo-brunnea,  $2.5-3\ \mu$  cr., apice plerumque subcrassiuscula usque  $6\ \mu$ , exteriore inconspicua, hyalina vel tincta, sparse minuteque verrucosa, humiliter papillata sed apparenter fere levi; pedicello hyalino, sporam aequante vel brevior, inornato.

*Lundia nitidula* DC. Santo Amaro, São Paulo, Brazil, Feb. 16, 1922, 1563 (type).

*Lundia* sp. Tremembé, São Paulo, Brazil, May 30, 1922, 1908.

This distinct species has the aspect of a microcyclic form but urediniospores and teliospores occur apparently equally abundantly in the primary sori. No other sori were observed. The teliospores appear nearly smooth.

312. *Prospodium palmatum* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, subcuticularibus, sparsis vel gregariis, parvis, rotundatis,  $0.1-0.3$  mm. diam., mox nudis, cinnamomeo-brunneis, pulverulentis, cuticula rupta inconspicuis; paraphysibus paucis, inconspicuis, incoloribus, cylindraceis,  $5-7 \times 30-45\ \mu$ ; uredosporis globosis, cum pariete exteriore inflato  $22-27\ \mu$  diam.; tunica laminata, intus cinnamomeo-brunnea,  $1-1.5\ \mu$  cr., extus hyalina, magnopere tumescente ad  $3-5\ \mu$ , moderate valdeque echinulata; poris 2, aequatorialibus.

III. Teleutosoris uredosoris conformibus, castaneo-brunneis; teleutosporis late ellipsoideis,  $22-25 \times 30-36\ \mu$ , utrinque rotundatis, septo vix vel non constrictis; tunica castaneo-brunnea,  $3-4\ \mu$  cr., non vel lentissime supra poros incrassata; lamina exteriore gelatinosa, inconspicua, moderate verrucosa; papillis conicis inter se  $2-3\ \mu$  distantibus; pedicello hyalino, sporam aequante vel leniter superante, plerumque lateraliter inserto, basi irregulariter palmato-ramificato.

*Tecoma alba* Cham. Poços de Caldas, São Paulo, Brazil, Apr. 10, 1922, 1722.

It is possible that *Uredo longiaculeata* P. Henn. may prove to belong here. The species is distinguished by the small urediniospores which have a diameter of  $16-19\ \mu$  excluding the outer wall, and by the peculiar palmately branched base of the teliospore pedicel.

313. *Prospodium reticulatum* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, subcuticularibus, sparsis, rotundatis, parvis, 0.2–0.3 mm. diam., tardius nudis, cinnamomeo-brunneis, pulverulentis; cuticula rupta conspicua; uredosporis obovatis, uno latere irregularibus, 22–25  $\times$  28–30  $\mu$ ; tunica tenui, non laminata, 1–1.5  $\mu$ , pallide cinnamomeo-brunnea, valde sparseque echinulata; poris parum obscuris, 2, subaequatorialibus.

III. Teleutosporis uredosoris immixtis, late ellipsoideis, 23–27  $\times$  36–42  $\mu$ , utrinque rotundatis, plerumque septo conspicue constrictis, tunica 3–3.5  $\mu$  cr., castaneo-brunnea, exteriore inconspicua, minute aequaliter reticulata; pedicello prope septum saepe inserto, hyalino, brevi.

*Bignoniaceae* (unidentified) Lapa, São Paulo, Brazil, June 4, 1922, 1942.

Only a few teliospores of this apparently distinct species were seen. The wall is beautifully and uniformly reticulated with fine, even meshes. The pedicel is short and, so far as could be determined, unadorned.

314. *Prospodium Stizophyllii* Jackson & Holway, sp. nov.

O. Pycnidii non visis, probaliter carentibus.

III. Teleutosoris hypophyllis, in maculis flavescentibus aggregatis, plerumque nerviculis et costis suffultis, elongatis 0.5–1.5 mm. longis, tardius nudis, pulverulentis, cuticula rupta cinctis; teleutosporis difformibus, aliis bicellularibus ellipsoideis, 23–26  $\times$  34–39  $\mu$ , utrinque rotundatis, plerumque septo visibiliter constrictis; aliis unicellularibus (mesosporis) parum irregulariter globosis, 24–33  $\mu$  diam., poro uno laterali instructis; tunica castaneo-brunnea, 2.5–3.5  $\mu$  cr., supra poros leniter incrassata, exteriore inconspicua, leniter tincta, minute rugoso-reticulata; pedicello hyalino vel leniter tincta, brevi, deciduo.

*Stizophyllum perforatum* Mier. Ave. Paulista Park. São Paulo, Brazil, March 5, 1922, 1613.

This is a very interesting species. The sori occur in groups on yellowish spots and extend along the veins or the midrib when the spot is in the centre of the leaf. The aspect is that of a microform. No pycnia were observed. The mesospores are as abundant as the two-celled spores and occur intermixed. At first glance one would be likely to interpret them as uredinio-spores but there is only one pore, always lateral, and the surface sculpturing is like that of the two-celled spores. The mesospores

appear to be flattened laterally so that, when the pore is in face view, the spore appears to be globose, when the pore is in optical section, the spore appears flattened on the side where the pore is located. Paraphyses were not observed.

315. **Prospodium tecomicola** (Speg.) Jackson & Holway, comb. nov.

*Puccinia tecomicola* Speg. Anal. Mus. Nac. Hist. Nat. Buenos Aires 31: 35. 1922.

*Tecoma* sp. Mogy das Cruces, São Paulo, Brazil, July 4, 1922, 2004.

This collection has been compared with the type of *P. tecomicola* Speg. and we can detect no essential difference.

316. **Uredo cerotelioides** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, rotundatis, parvis, 0.2–0.3 mm. diam., tarde nudis, diu epidermide tectis, pulveraceis, pallide cinnamomeo-brunneis; paraphysibus copiosis sed inconspicuis, sorum circumdantibus, plerumque incurvatis, brevibus,  $6-9 \times 24-36 \mu$ , apice obtusis, plerumque 1-septatis; tunica hyalina vel obscure cinnamomeo-brunnea, extus apiceque irregulariter incrassata; uredosporis obovatis,  $15-18 \times 24-28 \mu$ ; tunica hyalina vel pallide cinnamomeo-brunnea, tenui  $1 \mu$  minusve, minute crebreque verrucosa.

*Bignoniaceae* (unidentified) Garulhos, São Paulo, Brazil, June 1, 1922, 1927 (type); Juquery, São Paulo, Brazil, June 12, 1922, 1960.

This species is probably the uredinial stage of a *Cerotelium*. It differs markedly from *C. Holwayi*, primarily in the character of the sorus and in the paraphyses. In this species the paraphyses are short, much less conspicuous and obtuse at the apex.

317. **Uredo Delostomae** Jackson & Holway, sp. nov.

II. Uredosoris subcuticularibus, hypophyllis, sparsis, rotundatis, 0.3–0.5 mm. diam., mox nudis, pulverulentis, obscure cinnamomeo-brunneis, dein albidis, cuticula rupta inconspicua cinctis; uredosporis globosis,  $24-27 \mu$  diam.; pariete pallide castaneo-brunneo, tenui,  $1.5-2 \mu$ , moderate prominenter echinulato, poris obscuris praedito.

*Delostoma Morleyanum* Rose, Huigra, Chimborazo, Ecuador, Aug. 4, 1920, 840.

## SPECIES ON ACANTHACEAE

318. PUCCINIA BLECHI Lagerh. Bull. Soc. Myc. Fr. 11: 214. 1895.

*Blechnum Brownei* Juss. Guayaquil, Ecuador, July 30, 1920, 796.

The collection listed above is from the type locality for Lagerheim's species. Arthur (N. Am. Fl. 7: 415. 1921) lists the above name as a synonym of *P. Ruelliae* (B. & Br.) Lagerh. We prefer, for the present, however, to list the species separately.

319. PUCCINIA PARANAHYBAE P. Henn. Hedwigia 34: 320. 1895.

*Ruellia longifolia* (Pohl.) Griseb. Prata, São Paulo, Brazil, Apr. 7, 1922, 1707.

A microcyclic form which answers Henning's description well. The type has not been available. It was collected at Gogaz, Brazil, by Ule (No. 2004). An earlier collection recorded later (Hedwigia 35: 235. 1896) made at St. Catharina, Brazil (Ule, 908), is on the same host as the above. The species is also reported from Argentina.

320. *Puccinia praevara* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, quandoque epiphyllis, sparsis vel gregariis, in maculis decoloratis constipatis, parvis, rotundatis, 0.3–0.4 mm. diam., tarde nudis, pulverulentis, castaneo-brunneis, epidermide cinerea diu tectis; uredosporis globosis vel ellipsoideis, lateraliter parum depressis,  $21\text{--}27 \times 27\text{--}32 \mu$ ; pariete obscure castaneo-brunneo,  $2.5\text{--}3 \mu$  cr., minutissime moderateque echinulato, area levi circum poros 2 aequatoriales praedito.

III. Teleutosoris uredosoris conformibus; teleutosporis irregulariter ellipsoideis,  $24\text{--}28 \times 30\text{--}42 \mu$ , utrinque rotundatis, non vel lentissime septo constrictis; tunica castaneo-brunnea,  $2.5\text{--}4 \mu$  cr., supra poros leniter vel non incrassata, obscure verrucosorugosa; pedicello brevi, hyalino, deciduo, saepe lateraliter inserto.

*Ruellia viscidus* Nees. Guayaquil, Ecuador, July 31, 1920, 800.

321. PUCCINIA STENANDRI Dietel & Neger, in Engl. Bot. Jahrb. 22: 352. 1896.

*Stenandrium dulce* Nees. Panimavida, Chile, Dec. 17, 1919, 241.

This species appears to be distinct and was originally collected near Concepcion, Chile, on the same host. It does not appear to have been reported elsewhere.

322. **Uredo Aphelandrae** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis vel interdum in maculis decoloratis subhypertrophicis aggregatis, obscure cinnamomeo-brunneis, magnis, rotundatis, 0.5–1.0 mm. diam., tarde nudis, pulverulentis, epidermide rupta cinctis; uredosporis obovatis,  $21\text{--}27 \times 27\text{--}34 \mu$ ; tunica cinnamomeo-brunnea,  $1.5\text{--}2 \mu$  cr., sparse valdeque echinulata; poris prominentibus, 2, aequatorialibus.

*Aphelandra prismatica* Hiern. Alto da Serra, São Paulo, Brazil, June 14, 1922, 1970.

This species seems to differ from the following; though the spores are about the same size and have similar wall markings, the gross aspect of the two species is quite different.

323. **Uredo Cyrtantherae** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, in maculis decoloratis aggregatis, parvis, irregularibus, saepe confluentibus, 0.3–0.4 mm. diam., tardius nudis, pallide cinnamomeo-brunneis, pulverulentis, epidermide rupta cinctis; uredosporis late ellipsoideis vel obovoideis,  $21\text{--}24 \times 27\text{--}34 \mu$ ; tunica pallide aurato-brunnea,  $1.5\text{--}2.5 \mu$  cr., sparse valdeque echinulata, poris obscuris praedita.

*Cyrtanthera Sellowiana* Nees. Cantareira, São Paulo, Brazil, May 30, 1922, 1917.

SPECIES ON RUBIACEAE

324. **Aecidium borreriicola** Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis, plerumque epiphyllis, in maculis decoloratis aggregatis, profunde insidentibus, irregulariter ellipsoideis,  $90\text{--}120 \mu$  latis,  $90\text{--}135 \mu$  altis, prominenter periphysatis.

I. Aecidiis hypophyllis, per aream magnam 0.5–1.5 cm. diam., laxe sparsis, maculis decoloratis insidentibus, parvis, rotundatis,  $165\text{--}200 \mu$  diam., cupulatis vel breviter columnaribus, albidis; peridio albido, firmo, margine erecto parumque revoluta, eroso; cellulis peridialibus rhomboideis,  $18\text{--}20 \times 28\text{--}32 \mu$ , subforte imbricatis; pariete exteriori  $4\text{--}6 \mu$  cr., levi, interiori  $3\text{--}4 \mu$ , crasse verrucoso-rugoso; aecidiosporis ellipsoideis vel oblongis,  $12.5\text{--}15 \times 17\text{--}22 \mu$ ; tunica hyalina, tenui,  $1 \mu$  minusve, apice incrassata usque  $6 \mu$ , subtiliter crebreque verrucosa.

*Borreria angustifolia* C. & S. Campos do Jordão, São Paulo, Brazil, Apr. 30, 1922, 1794.

This species, while having somewhat the same general appearance, is quite different from *A. Holwayi* in aeciospore characters. The aecia are larger and the general appearance is somewhat coarser.

325. *Aecidium Fuchsiae* Jackson & Holway, sp. nov.

O. Pycnidiis paucis, inconspicuis, epiphyllis, subepidermicis, humilibus, parum triangularibus, non profunde insidentibus, 55–60  $\mu$  altis, 125–135  $\mu$  latis; inconspicue periphysatis.

I. Aecidiis hypophyllis, crebre in maculis leniter hypertrophicis rubidisque aggregatis, parvis, cupulatis; peridio flavescenti, margine eroso instructo; cellulis peridialibus contiguis vel leniter imbricatis, 15–18  $\times$  28–32  $\mu$ ; pariete exteriore crasso, 5–6  $\mu$ , levi, interiore 1.5–2  $\mu$ , crasse verrucoso-rugoso; aecidiosporis angulato-globosis, 18–24  $\mu$  diam. vel oblongis, 16–18  $\times$  21–24  $\mu$ ; tunica hyalina, tenui, 1–1.5  $\mu$ , minute sed visibiliter verrucosa.

*Fuchsia dependens* Hook. El Chaco, Prov. Sur Yungas, Bolivia, May 24, 1920, 643 (type).

*Fuchsia serratifolia* R. & P. San Felipe, Prov. Sur Yungas, Bolivia, May 21, 1920, 632.

326. *Aecidium Holwayi* Jackson, sp. nov.

O. Pycnidiis amphigenis, numerosis, in centro macularum decoloratarum aggregatis vel inter aecidia sparsis, profunde insidentibus, subepidermicis, globosis vel depresso globosis, 90–105  $\mu$  altis, 100–135  $\mu$  latis; periphysibus non extrusis.

I. Aecidiis hypophyllis, per areas magnas decoloratas 1–1.5 cm. diam. laxe sparsis, parvis, 125–135  $\mu$  diam., albidis, breviter cylindraceis, peridio erecto, firmo, margine eroso, albo; cellulis peridialibus regulariter rhomboideis, subforte imbricatis, 18–21  $\times$  28–32  $\mu$ ; pariete exteriore crasso, 5–7  $\mu$ , levi, interiore 2–3  $\mu$  cr., minute crebreque verrucoso-rugoso; aecidiosporis globosis vel late ellipsoideis, parvis, 11–13  $\times$  15–18  $\mu$ ; tunica hyalina, tenui, 1  $\mu$  minusve, inconspicue et subtilissime verrucosa sed apparenter levi.

*Borreria latifolia* (Aubl.) Schum. Mandaque, São Paulo, Brazil, March 23, 1922, 1670, May 25, 1922, 1893 (type).

A very different species from *Aecidium borreiiicola*, characterized by the small aecia occurring loosely scattered over considerable areas, but apparently not systemic. The aeciospores are small and not thickened at the apex.

327. *PUCCINIA AMBIGUA* (Alb. & Schw.) Lagerh. Bubak, Sitz.-ber. Böhm. Ges. Wiss. 1898: 14. 1898.

*Aecidium Galii ambiguum* Alb. & Schw. Consp. Fung. 116. 1805.

*Galium aparine* L. Viña del Mar, Chile, Sept. 10, 1919, 16;  
Concepcion, Chile, Oct. 29, 1919, 148.

A common -opsis form in North America and Europe, which does not seem to have been previously reported from South America.

328. *Puccinia Coccocypseli* Jackson & Holway, sp. nov.

O. Pycnidiis non visis, probaliter carentibus.

III. Teleutosoris hypophyllis, maculis flavescentibus insidentibus, in greges 3-8 mm. diam. dense confertis, saepe concentricae dispositis, cinnamomeo- vel pallide castaneo-brunneis, parvis, rotundatis vel parum irregularibus, 0.2-0.4 mm. diam., plerumque distinctis, mox nudis, pulvinatis, epidermide rupta plerumque inconspicuis; teleutosporis ellipsoideis vel oblongo-fusoideis, 10-13  $\times$  24-34  $\mu$ , supra rotundatis vel saepius obtusis, infra rotundatis vel quandoque ad pedicellum attenuatis, septo leniter vel non constrictis; tunica hyalina, vel pallide aurato-brunnea, 1-1.5  $\mu$ , supra leniter vel non incrassata usque 3  $\mu$ , levi; pedicello hyalino, fragili, sporam aequante vel saepius brevior.

*Coccocypselum Condalia* Pers. Campos do Jordão, São Paulo, Brazil, Apr. 27, 1922, 1777.

A micro-form with characters sufficiently distinct to justify separation.

329. *Puccinia concumulata* Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis cauliculisque, paucis, crebre gregariis, conspicuis, profunde insidentibus, magnis, subglobosis, 100-135  $\mu$  altis, 135-150  $\mu$  latis, periphysibus aegre conspicuis praeditis.

I. Aecidiis hypophyllis cauliculisque, paucis, maculis subhypertrophicis insidentibus, majusculis, cupulatis vel breviter cylindraceis; peridio flavescenti, erecto, firmo, margine eroso; cellulis peridialibus inter se firme conjunctis, parum imbricatis, 18-22  $\times$  28-34  $\mu$ ; pariete exteriore 3-5  $\mu$ , levi, interiore 1.5-2  $\mu$ , minute crebreque verrucoso; aecidiosporis angulato-globosis, 19-24  $\mu$ ; tunica hyalina, tenui, 1  $\mu$  minusve, minutissime verrucosa.

II. Uredosoris caulicolis, elongatis, castaneo-brunneis, tardius



nudis, pulverulentis, epidermide rupta cinctis; uredosporis late ellipsoideis,  $21-27 \times 30-38 \mu$ ; tunica castaneo-brunnea,  $2.5-3 \mu$  cr., minute sparseque echinulata; poris prominentibus, 4, aequatorialibus.

III. Teleutosoris cauliculis, elongatis, saepe confluentibus complures mm. caulem sequentibus, theobrominis, mox nudis, pulvinatis, epidermide rupta plerumque cinctis; teleutosporis variabilibus, oblongis, clavatis vel cylindraceis,  $15-22 \times 45-100 \mu$ , supra rotundatis vel saepius obtusis, infra plerumque attenuatis, septo leniter vel non constrictis; tunica tenui,  $1-1.5 \mu$ , ex aurato-castaneo-brunnea, apice incrassata ad  $6-10 \mu$ , levi; pedicello hyalino, sporam aequante vel duplo superante.

*Galium* sp. La Falda, Argentina, Aug. 14, 1922, 2023.

A very distinct and beautiful species easily separated from others on *Galium* by the urediniospore and teliospore characters. It is possible that *Aecidium Arechavaletae* Speg. may prove to be synonymous. No specimens have been available.

330. PUCCINIA LATERITIA Berk. & Curt. Jour. Acad. Sci. Phila. II, 2: 281. 1853.

*Puccinia spermacoces* Berk. & Curt. Grevillea 3: 53. 1894.

*Puccinia Houstoniae* Sydow, Hedwigia, Beibl. 40: 126. 1901.

*Diodia Radula* C. & S. Lapa, São Paulo, Brazil, March 24, 1922, 1673; Santa Anna, São Paulo, Brazil, May 25, 1922, 1878.

*Diodia rigida* (H.B.K.) C. & S. Sabara, Minas Geraes, Brazil, Dec. 2, 1921, 1360; Campinas, São Paulo, Brazil, Apr. 2, 1922, 1689.

*Spermacoce tenuior* L. Hacienda Anacuri, Nor Yungas, Bolivia, June 5, 1920, 724; Rio de Janeiro, Brazil, Aug. 27, 1921, 1076; Gavea, Rio de Janeiro, Brazil, Sept. 8, 1921, 1099; Prata, São Paulo, Brazil, Apr. 7, 1922, 1706; Guarajuá, São Paulo, Brazil, July 12, 1922, 2006.

331. PUCCINIA PUNCTATA Link, Ges. Nat. Freunde Berlin Mag. 7: 30. 1815.

*Puccinia Galii* Schw. Schr. Nat. Ges. Leipzig 1: 73. 1822.

*Galium cochabambense* Rusby, Cochabamba, Bolivia, March 10, 1920, 390.

332. UREDO BORRERIAE (P. Henn.) Kern & Whetzel, Mycologia 18: 42. 1926.

*Uromyces Borreriae* P. Henn. Hedwigia 35: 227. 1896.

*Borreria verticillata* (L.) Mey. Rio de Janeiro, Brazil, Aug. 10, 1921, 1011.

333. UREDO PSYCHOTRICOLA P. Henn. Hedwigia 34: 321. 1895.

*Palicourea crocea* R. & S. Portovelo, Prov. del Oro, Ecuador, Sept. 23, 1920, 1001.

*Psychotria* sp. Petropolis, Rio de Janeiro, Brazil, Oct. 22, 1921, 1242; Cantareira, São Paulo, Brazil, May 30, 1922, 1918.

334. UROMYCES EMMEORRHIZAE Sydow, Ann. Myc. 28: 38. 1930.

*Emmeorrhiza umbellata* (Spreng.) Schum. Hacienda La Florida, Sur Yungas, Bolivia, May 28, 1920, 672; Therezopolis, Rio de Janeiro, Brazil, Oct. 6, 1921, 1196.

This species was recognized as an undescribed species by Prof. Holway, who sent it to me in 1920, marked *Uromyces Emmeorrhizae* n. sp. It has, however, been recently described on the same host from Venezuela by Sydow. The collection from Bolivia shows old aecia, too imperfect for description, but their presence serves to indicate that the species is a long cycled form.

#### SPECIES ON VALERIANACEAE

335. *Puccinia vinulla* Jackson & Holway, sp. nov.

II. Uredosoris amphigenis, sparsis vel in maculis decoloratis aggregatis, circa sorum medianum saepe concentrice dispositis, rotundatis, 0.2–1.0 mm. diam., pallide aurato-brunneis, tarde nudis, pulverulentis, epidermide rupta cinctis, aparaphysatis; uredosporis ellipsoideis vel obovatis,  $18-21 \times 22-30 \mu$ ; tunica hyalina vel pallide flavo-brunnescenti,  $1.5-2.5 \mu$  cr., moderate parumque prominenter echinulata, poris obscuris praedita.

III. Teleutosoris, paucis, uredosoris conformibus, compactis; teleutosporis ellipsoideis vel late clavatis,  $18-22 \times 33-45 \mu$ , supra rotundatis, infra rotundatis vel attenuatis, septo leniter constrictis; tunica hyalina vel pallidissime flavescenti,  $1-1.5 \mu$  cr., angulis apiceque leniter incrassata ad  $2-3.5 \mu$ , levi; pedicello hyalino, sporam aequante vel brevior.

*Valeriana scandens* Loeffl. Campos do Jordão, São Paulo, Brazil, Apr. 21, 1922, 1746.

Distinguished by the nearly colorless smooth walled teliospores.

336. *Uredo quitensis* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, rotundatis vel quandoque elongatis, 0.4–1.0 mm. diam., pallide aurato-brunneis, tarde nudis, pulverulentis, epidermide inflata diu tectis, aparaphysatis; uredosporis ellipsoideis vel obovatis,  $21-24 \times 30-36 \mu$ ; tunica hyalina vel pallide flavescenti, 1–1.5  $\mu$  cr., moderate tenuiter echinulata, poris obscuris praedita.

*Valeriana microphylla* H.B.K. Quito, Ecuador, Aug. 23, 1920, 943.

This *Uredo* resembles somewhat the uredinial stage of the preceding species; the spores, however, are larger, the markings less prominent and somewhat more closely spaced. It doubtless belongs to a related species of *Puccinia*.

SPECIES ON CUCURBITACEAE

337. *Uromyces Anguriae* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis vel gregariis, obscure cinnamomeo-brunneis, suborbicularibus, 0.2–1.0 mm. diam., tarde nudis, pulverulentis, epidermide rupta cinctis; uredosporis ellipsoideis vel obovatis,  $18-21 \times 24-28 \mu$ ; tunica cinnamomeo-brunnea, 1.5–2  $\mu$ , minutissime sparsiusque echinulata; poris 2, subaequatorialibus.

III. Teleutosoris hypophyllis, sparsis vel gregariis, atro-brunneis, suborbicularibus, 0.2–0.5 mm. diam., tarde nudis, compactis, saepe epidermide cinerea diu tectis; teleutosporis subglobosis vel late ellipsoideis,  $24-27 \times 30-38 \mu$ , infra rotundatis sed supra obtusis vel acutis; tunica castaneo-brunnea, 2.5–4  $\mu$ , apice umbone pallidior supra porum incrassata ad 6–12  $\mu$ , minutissime obscurissime verrucoso-rugosa, apparenter levi, pedicello hyalino brevi deciduo praedita.

*Anguria Warmingiana* Cogn. Paineiras, Rio de Janeiro, Brazil, Aug. 17, 1921, 1045; Petropolis, Rio de Janeiro, Brazil, Dec. 29, 1921, 1432 (type).

Old aecia, too imperfect for proper description, are present in the first collection, indicating that the species is a eu-form. These are accompanied by prominent pycnia. The aecia appear

to be without evident peridium, deep seated, forming cavities in the somewhat hypertrophied tissues. The aeciospores are ellipsoid, 18–22 by 24–28  $\mu$ , with colorless walls, 1–1.5  $\mu$  thick, rather coarsely and prominently verrucose.

338. *UROMYCES NOVISSIMUS* Speg. Anal. Soc. Ci. Argent. 10: 134. 1880.

*Uredo novissimus* Speg. Anal. Mus. Nac. Buenos Aires 6: 235. 1899.

*Cayaponia tayuya* Mart. Gavea, Rio de Janeiro, Brazil, Sept. 8, 1921, 1095.

*Cayaponia* sp. Sylvestre, Rio de Janeiro, Brazil, Sept. 16, 1921, 1115.

339. *Uromyces ratus* Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis, paucis, punctiformibus, subepidermicis, obscure brunneis, profunde insidentibus, ellipsoideis, 90–105  $\mu$  latis, 105–120  $\mu$  altis; periphysibus non extrusis.

II. Uredosoris primariis amphigenis, gregariis, pycnidia circumdantibus, uredosoris secundariis sparsis vel gregariis, parvis, rotundatis, 0.3–0.8 mm. diam., mox nudis, obscure cinnamomeo-brunneis, pulverulentis, epidermide fissa cinctis; uredosporis ellipsoideis vel obovoideis, saepe triangularibus, 22–27  $\times$  27–32  $\mu$ ; tunica cinnamomeo-brunnea, tenui, 1–1.5  $\mu$ , parum prominenter sparseque echinulata; poris 2, aequatorialibus vel parum subaequatorialibus.

III. Teleutosoris hypophyllis, mox nudis, castaneo-brunneis, compactis, dein pulvinatis, tandem germinando cinerascens; epidermide rupta inconspicua; teleutosporis subglobosis vel ellipsoideis, 24–27  $\times$  27–38  $\mu$ , infra rotundatis sed supra obtusis; tunica 1.5–2  $\mu$  cr., pallide castaneo-brunnea, apice lamella pallidiore tunicae exterioris incrassata, levi; pedicello hyalino, sporam duplo aequante vel brevior.

*Cayaponia ternata* Cogn. Petropolis, Rio de Janeiro, Brazil, Oct. 27, 1921, 1251.

This species differs from *U. novissimus* Speg. in the larger urediniospores somewhat more prominently echinulate. In the latter species the urediniospores are 20–28  $\mu$  long with decidedly subequatorial pores. The teliospores are much the same in the two species, perhaps slightly smaller in *U. novissimus*, which also has slightly thicker walls, concolorous at apex.

The size of both spores in *U. ratus* is smaller than in *U. Cayaponiae* P. Henn.

## SPECIES ON CARDUACEAE

(Tribe Vernonieae)

340. COLEOSPORIUM ELEPHANTOPODIS (Schw.) Thüm. Myc. Univ. 953. 1878.

*Uredo Elephantopodis* Schw. Schr. Nat. Ges. Leipzig 1: 70. 1822.

*Elephantopus mollis* H.B.K. Hacienda La Florida, Sur Yungas, Bolivia, May 26, 1920, 655; Paissaguera, Near Santos, São Paulo, Brazil, Feb. 9, 1922, 1548.

*Elephantopus* sp. Jardim Botânico, Rio de Janeiro, Brazil, Aug. 11, 1921, 1016; Guarujá, Santos, São Paulo, Brazil, July 13, 1922, 2012.

*Orthopappus angustifolius* (Sw.) Gleason, Piassaguera, Near Santos, São Paulo, Brazil, Feb. 9, 1922, 1546; Cantareira, São Paulo, Brazil, Feb. 18, 1922, 1570.

341. PUCCINIA PIPTOCARPHAE P. Henn. Hedwigia 35: 240. 1896.

*Piptocarpha cinerea* (Sch. Bip.) Baker, Therezopolis, Rio de Janeiro, Brazil, Oct. 9, 1921, 1201.

*Piptocarpha oblonga* (Gardn.) Baker, Bosque da Saude, São Paulo, Brazil, Jan. 31, 1922, 1522.

*Piptocarpha oblonga ovatifolia* Baker, Bosque da Saude, São Paulo, Brazil, Jan. 31, 1922, 1519, May 27, 1922, 1897.

*Piptocarpha* sp. Barbacena, Minas Geraes, Brazil, Dec. 13, 1921, 1394; Villa Prudente, São Paulo, Brazil, June 9, 1922, 1945; Guarujá, Santos, São Paulo, Brazil, July 12, 1922, 2009.

All the collections showing absence of paraphyses and with teliospores about 45–60  $\mu$  long are included here. There seems to be considerable variation in both teliospores and urediniospores. It is possible that there are more species in this group than have been recognized.

342. *Puccinia seorsa* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis in greges confertos dispositis, maculis magnis decoloratis insidentibus, punctiformibus, globosis,

magnis, profunde insitis, 210–270  $\mu$  diam., periphysibus non extrusis.

I. Aecidiis hypophyllis, paucis, pycnidiis contrappositis, peridio firmo flavescenti cylindraceo praeditis; cellulis peridialibus oblongis, 15–18  $\times$  45–60  $\mu$ , leniter imbricatis, tunica exteriore 2–3  $\mu$  cr., levi, interiore 2–3  $\mu$  cr., crebre prominenter verrucosa; aecidiosporis globosis vel late ellipsoideis, 24–30  $\times$  28–36  $\mu$ , tunica hyalina vel pallide aurato-brunnea, 2–2.5  $\mu$  cr., prominenter minuteque verrucosa.

II. Uredosoris hypophyllis, sparsis vel gregariis, parvis, rotundatis, 0.2–0.4 mm. diam., castaneo-brunneis, mox nudis, pulverulentis; epidermide rupta non visibili; paraphysibus copiosis, solum circumdantibus, curvatis, longitudine 50–160  $\mu$  et latitudine 12–18  $\mu$ ; variabilibus; tunica uniformiter tenui 1  $\mu$  minusve vel saepius convexo latere ad 3  $\mu$  irregulariter incrassata; uredosporis globosis vel late ellipsoideis 26–30  $\times$  28–32  $\mu$ ; tunica castaneo-brunnea, 2–3  $\mu$  cr., moderate prominenterque echinulata, poris 4 sparsis praedita.

III. Teleutosoris hypophyllis, sparsis, pulvinatis, castaneo-brunneis, ob germinationem cinerascentibus; paraphysibus uredosoris conformibus; teleutosporis cylindraceis vel oblongis, longitudine variabilibus, 16–26  $\times$  50–120  $\mu$ , supra obtusis, infra ad pedicellum contractis, cellula superiore fusiformi praeditis, septo leniter constrictis; tunica pallide castaneo-brunnea, tenui, 1  $\mu$ , angulis cellulae inferioris leniter sed uno latere pori germinativi apice usque 3  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Piptocarpha axillaris* (Less.) Baker, Taipas, São Paulo, Brazil, Feb. 6, 1922, 1540 (type); Mandaque, São Paulo, Brazil, May 25, 1922, 1893–1/2.

*Piptocarpha* sp. Petropolis, Rio de Janeiro, Brazil, Oct. 18, 1921, 1227; São Paulo, Brazil, Jan. 23, 1922, 1494; Bosque da Saude, São Paulo, Brazil, Jan. 29, 1922, 1508; Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 6, 1922, 1805.

This long cycled species is distinguished by the presence of abundant paraphyses with the diploid sori and by the teliospore characters. The teliospores are quite variable in length in different collections. They all have the pore of the apical cell slightly at one side and the thickening is greater on one side.

343. *Puccinia valentula* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, rotundatis, parvis, 0.2–0.4 mm. diam., mox nudis, obscure cinnamomeo-brunneis, pulverulentis; epidermide fissa visibili; paraphysibus soro circumdantibus, copiosis, cylindraceis vel leniter incurvatis,  $12-22 \times 90-160 \mu$ , tunica uniformiter tenui,  $1 \mu$  minusve, apice quandoque, ad  $3 \mu$  incrassata, aurato-brunnea; uredosporis globoideis,  $24-27 \mu$ ; pariete pallide cinnamomeo-brunneo,  $2-2.5 \mu$  cr., minutissime moderatissimeque echinulato, poris obscuris (3 pluribusve) praedito.

III. Teleutosoris uredosoris conformibus, castaneo-brunneis, pulverulentis; paraphysibus uredosoris conformibus; teleutosporis late ellipsoideis vel subglobosis,  $26-30 \times 32-36 \mu$ , utrinque rotundatis, non constrictis; tunica castaneo-brunnea,  $2.5-3 \mu$  cr., supra poros vix sed magnopere angulis incrassata, minute inconspicue verrucosa sed apparenter levi; poro cellulae inferioris basali; pedicello hyalino, brevi, deciduo.

*Piptocarpha axillaris* (Less.) Baker, São Paulo, Brazil, Feb. 6, 1922, 1539 (type).

*Piptocarpha* sp. São Paulo, Brazil, Feb. 15, 1922, 1562.

A species with very different characters from any previously described on *Piptocarpha*. It is possible that in collection 1562 there is some mixture with *P. seorsa*.

344. *Puccinia Vanillosmopsisidis* Jackson & Holway, sp. nov.

O. Pycnidiis non visis, probaliter carentibus.

III. Teleutosoris hypophyllis, gregariis, in maculis decoloratis dense congregatis, parvis, rotundatis, 0.2–0.4 mm. diam., castaneo-brunneis, serius nudis, pulverulentis, epidermide rupta cinctis; teleutosporis late ellipsoideis,  $18-21 \times 24-30 \mu$ , utrinque rotundatis, vix constrictis; tunica pallide castaneo-brunnea,  $2.5-3 \mu$ , supra poros vix constrictis, minute verrucosa; poro cellulae superioris apicali, poro cellulae inferioris prope pedicellum sito; pedicello hyalino, brevissimo, deciduo.

*Vanillosmopsis erythropappa* (DC.) Sch. Bip. Petropolis, Rio de Janeiro, Brazil, Nov. 9, 1921, 1287; Tijuca, Rio de Janeiro, Brazil, Dec. 23, 1921, 1420 (type).

This species has the aspect of a micro-form, and appears to differ from other species of similar life history on related hosts.

345. *Uredo illaudanda* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, gregariis, rotundatis, 0.2–0.4 mm. diam., tarde nudis, obscure cinnamomeo-brunneis,

pulverulentis, epidermide rupta cinctis, aparaphysatis; uredosporis late ellipsoideis vel obovatis,  $23-25 \times 29-31 \mu$ ; tunica cinnamomeo-brunnea,  $2-2.5 \mu$ , moderate minuteque echinulata, poris 3 fere aequatorialibus praedita.

*Vanillosmopsis erythropappa* (DC.) Sch. Bip. Therezopolis, Rio de Janeiro, Brazil, Oct. 4, 1921, 1192.

#### SPECIES ON VERNONIA

In the study of the Holway collections on *Vernonia* a considerable number (11) of apparently undescribed species of *Puccinia* have been encountered. Since there have been 26 species previously described on this host genus, it has seemed desirable to furnish a key to the known species, which will serve to indicate the basis on which we have separated the species which are being described as new. The writer has previously published an account of the species of *Puccinia* occurring on the Vernonieae (Bot. Gaz. 65: 289-312. 1918). A key to all the species known at that time was included (l.c., pp. 291-293). Since all of the species described in this paper fall in the smooth spored section, only the first half of the key has been revised and included here. For a key to the rough spored species, the reader is referred to the paper cited above.

#### KEY TO SPECIES OF PUCCINIA ON VERNONIA

Teliospore wall smooth or appearing so, often obscurely rugose.

Teliospore wall colorless or light cinnamon-brown, smooth.

Teliospore wall uniformly thin, rarely slightly thickened above.

Teliospores averaging more than  $60 \mu$  in length.

Aecia present in life history.

Peridium present.

Paraphyses present in the telia.....

346. *P. angitonalis*.

Paraphyses absent in the telia.

Teliospores  $12-18 \mu$  in width.

Urediniospore wall closely echinulate...

347. *P. allaudabilis*.

Urediniospore wall moderately to sparsely echinulate..

348. *P. Becki*.



- Teliospores 18–20  $\mu$  in width.  
 Urediniospores unknown; peridial cell wall rugose. . . . . *P. membranacea.*  
 Urediniospores present; peridial cell wall verrucose. . . . . 354. *P. improvisa.*  
 Peridium wanting; urediniospores 23–28 by 29–34  $\mu$ . . . . . *P. erratica.*  
 Aecia lacking in life history or unknown.  
 Teliospores averaging over 18  $\mu$  wide.  
 Brachy-form; teliospores 16–24 by 56–80  $\mu$ . . . . . *P. Arthuriana.*  
 Micro-form; teliospores 20–27 by 45–70  $\mu$ . . . . . *P. vernoniicola.*  
 Teliospores averaging less than 18  $\mu$  wide. . . . . 353. *P. impetrabilis.*  
 Teliospores averaging less than 60  $\mu$  in length.  
 Teliospores less than 40  $\mu$  long. . . . . *P. Vernoniae-mollis.*  
 Teliospores more than 40  $\mu$  long.  
 Brachy-form; urediniospore wall 1.5–2.5  $\mu$  thick. . . . . *P. insulana.*  
 Eu-form; urediniospore wall 1–1.5  $\mu$  thick. . . . . *P. fraterna.*  
 Teliospores appreciably thickened above.  
 Teliospore wall light-brown (South America).  
 Paraphyses absent. . . . . 352. *P. illatabilis.*  
 Paraphyses present.  
 Paraphyses conspicuous.  
 Paraphyses uniformly thin walled. . . . . 349. *P. deprecanea.*  
 Paraphyses thickened on one side. . . . . 361. *P. veniabilis.*  
 Paraphyses inconspicuous, thin walled.  
 Urediniospores closely echinulate. . . . . 351. *P. fundata.*  
 Urediniospores sparsely echinulate. . . . . 358. *P. pestibilis.*  
 Teliospore wall colorless (Ceylon). . . . . *P. clara.*  
 Teliospore wall dark-cinnamon or chestnut-brown, thickened at apex, in some species obscurely verrucose-rugose.  
 Uredinia unknown; teliospores chestnut-brown, smooth.

- Opsis-form—(Africa) . . . . . *P. Le Testui.*  
 Micro-form—(Africa) . . . . . *P. inflorescenticola.*
- Uredinia present; teliospores dark-cinnamon  
 or chestnut-brown, rounded below.  
 Urediniospore wall golden or cinnamon-  
 brown.  
 Urediniospore pores 4–6 scattered.  
 Teliospores averaging over  $40\ \mu$   
 long.  
 Teliospore wall  $3\text{--}5\ \mu$  thick.  
 Teliospore wall light chest-  
 nut-brown . . . . . 357. *P. pertrita.*  
 Teliospore wall dark chest-  
 nut-brown . . . . . 362. *P. vernoniphila.*  
 Teliospore wall  $1.5\text{--}2\ \mu$  thick. *P. fuscella.*  
 Teliospores averaging less than  
 $40\ \mu$  long . . . . . 350. *P. fausta.*  
 Urediniospore pores 2–3 approxi-  
 mately equatorial.  
 Teliospores averaging less than  
 $60\ \mu$  long.  
 Teliospores  $20\text{--}28$  by  $30\text{--}45\ \mu$ . *P. Vernoniae.*  
 Teliospores  $21\text{--}30$  by  $40\text{--}60\ \mu$ . 356. *P. Lorentzii.*  
 Teliospores averaging over  $60\ \mu$   
 long . . . . . 352. *P. illatabilis.*  
 Urediniospore wall colorless to faint  
 golden-brown . . . . . 360. *P. semiinsculpta.*  
 Teliospore wall prominently roughened (see Bot.  
 Gaz. 65: 292–293. 1918).

346. ***Puccinia agnitionalis*** Jackson & Holway, sp. nov.

O & I. Pycnidiis atque aecidiis praesentibus (vide argu-  
 mentum).

II. Uredosoris non visis; uredosporis in teleutosoris sitis,  
 ellipsoideis,  $18\text{--}22 \times 26\text{--}30\ \mu$ ; tunica hyalina vel pallide aurato-  
 brunnea,  $1.5\text{--}2\ \mu$  cr., crebre minute echinulata, poris obscuris  
 3 pluribusve sparsis instructa.

III. Teleutosoris hypophyllis, numerosis, sparsis vel gregariis,  
 rotundatis,  $0.4\text{--}0.8$  mm. diam., mox nudis, primum pallide  
 castaneo-brunneis, deinde germinando cinerascens, com-  
 pactis, pulvinatis; epidermide fissa inconspicua; paraphysis  
 copiosis, soris circumdantibus vel inter teleutosporas sparsis,  
 clavatis, rectis vel subcurvatis, pallide cinnamomeo-brunneis,  
 $18\text{--}24\ \mu$  latis,  $125\text{--}175\ \mu$  longis, apice rotundatis, tunica uni-  
 formiter tenui  $1\ \mu$  minusve praeditis; teleutosporis oblongis vel  
 cylindraceis, depressulis,  $18\text{--}20\ \mu$  vel  $22\text{--}26\ \mu$  latis, diverse visis,  
 $65\text{--}90\ \mu$  longis, infra rotundatis, supra attenuatis, e facie con-  
 spicue constrictis; tunica cinnamomeo-brunnea, aequaliter  $1\text{--}$

1.5  $\mu$  cr., levi; pedicello hyalino, sporam dimidiam aequante vel brevior.

*Vernonia diffusa* Less. Therezopolis, Brazil, Oct. 2, 1921, 1184.

This species is separable from other species of *Puccinia* reported on *Vernonia* by the thin teliospore walls essentially unthickened at the apex, and the presence of thin walled paraphyses accompanying the telia.

Old aecia accompanied by pycnia are present, indicating that the species is a long cycled form. The pycnia are epiphyllous, deep seated, 90–120  $\mu$  wide by 120–150  $\mu$  high, with short ostiolar filaments. The aecia are amphigenous, with well developed membranous peridia. The peridial cells were seen only in face view and are irregularly polyhedral, 16–23 by 40–50  $\mu$ . The aeciospores are ellipsoid, 18–20 by 26–30  $\mu$ , with colorless walls 1–1.5  $\mu$  thick, closely and finely verrucose.

347. *Puccinia allaudabilis* Jackson & Holway, sp. nov.

O, I. Pycnidiis et aecidiis praesentibus (v. infra).

II. Uredosoris hypophyllis, paucis, sparsis, rotundatis, 0.5–1 mm. diam., pallide cinnamomeo-brunneis, mox nudis, pulverulentis, epidermide rupta inconspicuis; uredosporis globoideis vel late ellipsoideis, 20–24  $\times$  22–26  $\mu$ ; tunica tenui 1.5–2  $\mu$ , crebre tenuiter echinulata; poris subobscuris, 3–4, sparsis.

III. Teleutosoris hypophyllis, copiosis, sparsis vel gregariis, parvis, 0.5–0.8 mm. diam., mox nudis, pulvinatis, castaneo-brunneis, germinando cinerascens, epidermide rupta plerumque inconspicuis, paraphysatis; teleutosporis cylindraceutis vel teretibus, 15–19  $\times$  60–78  $\mu$ , infra ad pedicellum rotundatis vel contractis, ad apicem obtusis vel paulatim angustatis, leniter vel non constrictis; tunica cinnamomeo-brunnea, uniformiter tenui, 1–1.5  $\mu$ , levi; pedicello hyalino, fragili, sporam aequante vel brevior.

*Vernonia argyrotrichia* Sch. Bip. Therezopolis, Rio de Janeiro, Brazil, Oct. 8, 1921, 1199 (type); Oct. 11, 1921, 1212.

This species may be distinguished from others on *Vernonia* by the slender, thin walled teliospores, not thickened at the apex and not over 20  $\mu$  wide, together with the thin walled, closely echinulate urediniospores.

A few old aecia accompanied by pycnia are present, but are too imperfect for adequate diagnosis. The pycnia are epiphyllous, deep seated, nearly globose, 120–150  $\mu$  wide by 150  $\mu$  high, with short ostiolar filaments. The aecia are hypophyllous, with membranous, lacerate peridium. The peridial cells seen in face view are irregularly polyhedral, 23–28 by 40–60  $\mu$ . The wall is coarsely and prominently tuberculate verrucose. The aeciospores are ellipsoid, 20–30 by 24–26  $\mu$ , with colorless thin walls, 1–1.5  $\mu$ , coarsely and prominently verrucose, with a tendency to be verrucose rugose near one end.

348. PUCCINIA BECKI Mayor, Mém. Soc. Neuch. Sci. Nat. 5: 509. 1913.

*Vernonia arborescens* Sw. Huigra, Chimborazo, Ecuador, Aug. 6, 1920, 848.

*Vernonia argyrotichia* Sch. Bip. Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 9, 1922, 1832.

The collections listed are referred to *P. Becki* tentatively. Neither agrees perfectly with the type, though both have long narrow teliospores not thickened at the apex. The collection on *V. arborescens* differs in having larger, thicker walled urediniospores and teliospores which reach a maximum length of 100  $\mu$ . The collection on *V. argyrotichia* is quite different from one on the same host referred to *Puccinia allaudabilis* Jackson & Holway. In the latter collection the urediniospore markings are closely placed and the teliospores reach a maximum length of 78  $\mu$ . In the collection referred here, the urediniospore markings are moderately to sparsely placed and the teliospores average over 75  $\mu$  in length and reach a maximum of 120  $\mu$ .

*P. Becki* was described from a collection made in Colombia on *V. Cotoneaster*, which bore uredinia and telia only. Both collections listed above bear aecia. A collection made in Jamaica and referred to *P. Becki* by the writer (Bot. Gaz. 65: 293. 1918) also bore aecia.

It seems probable that there may be several long cycled species having long narrow teliospores unthickened at the apex and not accompanied by paraphyses, separable primarily on aecial and uredinial characters. We hesitate, however, to describe either

of the above collections as new. More ample material on a number of hosts will be needed before specific limits can be determined in this group of *Vernonia* rusts.

349. ***Puccinia deprecanea*** Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis, punctiformibus, profunde insidentibus, ampullaceis, 85–95  $\mu$  latis, 110–125  $\mu$  altis; periphysibus prominentibus.

I. Aecidiis amphigenis, paucis 1–6, circum pycnidia in maculis decoloratis dense aggregatis; peridio delicato, albo, lacerato, mox scissili; cellulis peridialibus e facie irregulariter polygonis, 20–23  $\times$  26–30  $\mu$ , tunica minute crebreque verrucoso-tuberculata vel verrucoso-rugosa; aecidiosporis globosis vel late ellipsoideis, 20–24  $\times$  26–30  $\mu$ ; tunica hyalina, 1.5–2.5  $\mu$ , minute crebreque verrucoso-tuberculata, rugoso-striata, striam uno latere efformante.

II. Uredosoris hypophyllis, sparsis vel gregariis, parvis, rotundatis, 0.2–0.5 mm. diam., cinnamomeo-brunneis, mox nudis, pulverulentis, epidermide rupta inconspicuis; paraphysibus copiosis, soro circumdantibus, cylindraceis vel clavatis, parum incurvatis, 20–30  $\times$  110–175  $\mu$ , supra rotundatis sed infra attenuatis, tunica uniformiter tenui 1  $\mu$  minusve praeditis; uredosporis obovatis, 20–23  $\times$  23–28  $\mu$ , tunica incolori tenui 1–1.5  $\mu$  minute moderateque echinulata et poris obscuris instructis.

III. Teleutosoris hypophyllis, uredosoris conformibus sed pulvinatis, castaneo-brunneis, e germinatione cinereis; paraphysibus uredosoris conformibus; teleutosporis oblongis vel clavatis, 20–26  $\times$  50–65  $\mu$ , supra rotundatis, infra rotundatis vel pedicellum versus contractis, leniter vel non constrictis; tunica tenui, 1–1.5  $\mu$ , septo loculi inferioris et utroque latere pori germinativi apice ad 4  $\mu$  incrassata, levi; pedicello hyalino, brevi, deciduo.

*Vernonia* sp. Juquery, São Paulo, Brazil, June 12, 1922, 1962.

This species is easily distinguished from other *Vernonia* rusts by the presence of abundant, conspicuous thin walled paraphyses, and the thin walled light colored teliospores appreciably thickened at the apex.

350. ***Puccinia fausta*** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis vel saepius gregariis, rotundatis, 0.3–0.5 mm. diam., mox nudis, pulverulentissimis, cinnamomeo-brunneis; epidermide rupta inconspicua; uredosporis globosis, ellipsoideis vel obovoideis, 20–22  $\times$  24–28  $\mu$ ; tunica

hyalina vel pallide aurato-brunnea, 2–2.5  $\mu$  cr., minute subsparsaeque echinulata; poris obscuris, 4–6, sparsis.

III. Teleutosoris non visis; teleutosporis in uredosoris sitis, late ellipsoideis, 27–30  $\times$  35–40  $\mu$ , utrinque rotundatis, septo non constrictis; tunica castaneo-brunnea, 3–4  $\mu$  cr., supra poros leniter incrassata ad 5–6  $\mu$ , obscurissime verrucoso-rugosa sed apparenter levi, pedicello hyalino brevi deciduo et poro cellulae inferioris mediano praedita.

*Vernonia macrophylla* Less. Therezopolis, Rio de Janeiro, Brazil, Oct. 13, 1921, 1216.

This species is separable from *P. inaequata* by the nearly smooth walled teliospores and the scattered uredinial pores.

351. ***Puccinia fundata*** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, parvis, rotundatis. 0.4–0.8 mm. diam., pallide cinnamomeo-brunneis, mox nudis, pulverulentis; epidermide rupta inconspicua; paraphysibus inconspicuis, numerosis, soro circumdantibus, rectis vel incurvatis, 15–20  $\times$  60–90  $\mu$ ; tunica hyalina vel leniter tinctorum, uniformiter tenui 1  $\mu$  minusve; uredosporis obovatis vel late ellipsoideis, 19–23  $\times$  26–30  $\mu$ ; tunica tenui, 1–1.5  $\mu$ , hyalina vel pallidissime aurato-brunnea, creberrime et minutissime echinulata, poris obscuris praedita.

III. Teleutosoris hypophyllis, sparsis vel gregariis, parvis, rotundatis, 0.2–0.5 mm. diam., mox nudis, primum pallide castaneo-brunneis, deinde germinando cinereis, compactis, pulvinatis; epidermide rupta inconspicua; paraphysiribus uredoso conformibus; teleutosporis clavatis vel late ellipsoideis, 24–28  $\times$  44–65  $\mu$ , supra rotundatis, infra rotundatis vel angustatis, leniter vel non constrictis; tunica tenui 1–1.5  $\mu$ , cinnamomeo-brunnea, septo apiceque incrassata ad 6–9  $\mu$ , levi; pedicello hyalino, fragili, sporam aequante vel brevior.

*Vernonia discolor* (Spreng.) Less. Rio de Janeiro, Brazil, Nov. 12, 1921, 1294 (type).

*Vernonia* sp. Petropolis, Rio de Janeiro, Brazil, Oct. 30, 1921, 1261.

Distinguishable from other *Vernonia* rusts by the presence of thin walled paraphyses and thin walled light colored teliospores broadly thickened at apex.

352. ***Puccinia illatabilis*** Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis, gregariis, areas decoloratas subhypertrophicis occupantibus, punctiformibus, profunde in-

sidentibus, ellipsoideis, 110–125  $\mu$  latis, 135–150  $\mu$  altis; periphysibus non prominentibus.

I. Aecidiis epiphyllis, paucis, magnis, 0.25–0.4 mm. diam., profunde insidentibus; peridio cylindraceo vel saccato, firmo, albo; cellulis peridialibus e facie 20–28  $\times$  36–54  $\mu$ ; tunica minute crebreque verrucosa; aecidiosporis irregulariter ellipsoideis vel globoideis, 20–23  $\times$  24–48  $\mu$ ; tunica pallide aurato-brunnea, 1.5–2  $\mu$  cr., una fine ad 3–5  $\mu$  incrassata, crassius crebrius verrucoso-tuberculata, verrucis incrassata fine prominulioribus.

II. Uredosoris hypophyllis, sparsis, parvis, rotundatis, 0.2–0.4 mm. diam., tardius nudis, cinnamomeo-brunneis, pulverulentis, epidermide rupta cinctis, aparaphysatis; uredosporis ellipsoideis vel obovatis, 21–24  $\times$  26–30  $\mu$ ; tunica obscure cinnamomeo-vel pallide castaneo-brunnea, 1.5–2  $\mu$  cr., minute crebriusque echinulata; poris 3, fere aequatorialibus.

III. Teleutosoris hypophyllis, sparsis, parvis, rotundatis, 0.2–0.3 mm. diam., mox nudis, castaneo-brunnea, pulvinatis; epidermide rupta plerumque inconspicua; teleutosporis ellipsoideis, cylindraceis vel clavatis 15–24  $\times$  54–90  $\mu$ , infra rotundatis vel angustatis, supra rotundatis vel obtusis, plerumque conspicue constrictis; tunica cinnamomeo- usque castaneo-brunnea, 1–1.5  $\mu$  cr., apice ad 6–12  $\mu$  visibiliter incrassata; pedicello hyalino, sporam subaequante.

*Vernonia scorpioides* Pers. Coroico, Nor Yungas, Bolivia, June 11, 1920, 729.

Distinguished from other *Vernonia* rusts by the epiphyllous aecia, the long narrow teliospores strongly thickened above and the entire absence of paraphyses. The teliospores are much like those of *P. veniabilis*. The pore of the upper cell is at one side of the thickened apex and that of the lower cell at the septum is not in line with the upper pore but in a plane at right angles so that the two pores are not in view at the same time.

353. *Puccinia impetrabilis* Jackson & Holway, sp. nov.

II. Uredosoris amphigenis sed plerumque hypophyllis, sparsis, rotundatis, 0.5–0.8 mm. diam., mox nudis, cinnamomeo-brunneis, pulverulentis, epidermide rupta plerumque cinctis; uredosporis late ellipsoideis vel globosis, 26–28  $\times$  28–32  $\mu$ ; tunica pallide cinnamomeo-brunnea vel subhyalina, 3–4  $\mu$  cr., valde sparseque echinulata, poris obscuris instructa.

III. Teleutosoris hypophyllis, paucis, sparsis, rotundatis, parvis, 0.4–0.6 mm. diam., mox nudis, compactis, pulvinatis, pallide castaneo-brunneis, germinando cinerascentibus; epider-

mide rupta non visibili; teleutosporis cylindraceis,  $15-18 \times 65-95 \mu$ , basi truncatis, apice obtusis vel teretibus, vix constrictis; tunica cinnamomeo-brunnea, tenui  $1-1.5 \mu$ , apice non incrassata, levi; pedicello hyalino, fragili, sporam aequante vel brevior.

*Vernonia sericea* Rich. Rio de Janeiro, Brazil, Nov. 12, 1921, 1295.

*Vernonia* sp. Therezopolis, Rio de Janeiro, Brazil, Oct. 15, 1921, 1222; Petropolis, Rio de Janeiro, Nov. 1, 1921, 1265 (type).

This species is somewhat like *P. erratica* Jackson & Holway, but may be distinguished from it and all others by the narrow teliospores and the very thick walled, sparsely echinulate urediniospores and the absence of paraphyses. In the collection on *V. sericea* the urediniospore wall is not quite so thick as described. The collection is referred to this species provisionally.

354. ***Puccinia improvisa*** Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis 2-5, in areis decoloratis subhypertrophicis crebre aggregatis, punctiformibus, profunde insidentibus, subglobosis,  $140-150 \mu$  diam.; periphysibus brevibus.

I. Aecidiis hypophyllis, pycnidiis contrappositis, paucis 2-5, magnis,  $0.2-0.4$  mm. diam.; peridio conspicue adulto, cylindraceo vel saccato, albo vel flavescenti; loculis peridialibus e facie irregulariter polygonis,  $20-26 \times 45-60 \mu$ ; tunica crebre minuteque sed prominenter verrucosa; aecidiosporis late ellipsoideis, saepe fine superiore obtusis vel subacutis,  $22-26 \times 30-36 \mu$ ; tunica hyalina,  $2-3 \mu$  cr., prominenter sed minute verrucoso-tuberculata.

II. Uredosoris plerumque hypophyllis, paucis, sparsis vel gregariis, rotundatis,  $0.5-1.0$  mm. diam., mox nudis, cinnamomeo-brunneis, pulverulentis, epidermide rupta plerumque cinctis, paraphysatis; uredosporis late ellipsoideis vel obovoideis,  $24-28 \times 28-32 \mu$ ; tunica pallide cinnamomeo-brunnea vel fere hyalina,  $2-3 \mu$  cr., prominenter sparsiusque echinulata, poris obscuris instructa.

III. Teleutosoris hypophyllis, numerosis, sparsis vel gregariis, rotundatis, parvis,  $0.2-0.5$  mm. diam., mox nudis, castaneo-brunneis, ob germinationem cinerascens; epidermide rupta non visibili; teleutosporis ellipsoideis, oblongis vel cylindraceis,  $18-26 \times 58-88 \mu$ , infra rotundatis, supra rotundatis vel obtusis, septo leniter constrictis; tunica cinnamomeo-brunnea, uniformiter tenui,  $1-1.5 \mu$ , levi; pedicello hyalino, sporam aequante vel brevior.



*Vernonia eriolepis* Gardn. Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 9, 1922, 1836.

*Vernonia subsquarrosa* DC. Rio de Janeiro, Brazil, Aug. 13, 1921, 1030; Aug. 23, 1921, 1064 (type).

This species is somewhat like *P. impetrabilis* Jackson & Holway, differing in the length and width of the teliospores and in the shape. In this species the apex is usually rounded, while in the *P. impetrabilis* the upper cell usually tapers gradually to the apex.

A comparison has been made with *P. membranacea* Dietel. Our species differs markedly in the size and character of the aecia. In *P. membranacea* the peridium is lacerate, not highly developed, and the wall markings are distinctly rugose.

The collection on *V. eriolepis* is placed here provisionally. The aeciospores are somewhat more strongly marked and it may prove to be better assigned elsewhere. The teliospores are narrower and more like those of *P. allaudabilis*, but the urediniospores correspond better with this species.

355. PUCCINIA INAEQUATA Jackson & Holway; Arth. Bot. Gaz. 65: 309. 1918.

*Bullaria inaequata* Arth. & Mains, N. Am. Fl. 7: 498. 1922.

*Vernonia paludosa* Gardn. Campos do Jordão, São Paulo, Brazil, Apr. 23, 1922, 1757; Apr. 28, 1922, 1783, 1785.

*Vernonia patens* H.B.K. Huigra, Chimborazo, Ecuador, Aug. 6, 1920, 853.

*Vernonia Westiniana* Less. Campos do Jordão, São Paulo, Brazil, Apr. 21, 1922, 1750; Garulhos, São Paulo, Brazil, June 1, 1922, 1931; Curityba, Brazil, June 20, 1922, 1974.

*Vernonia* (Near *V. Beyrichii* Less.) Garulhos, São Paulo, Brazil, June 1, 1922, 1932.

This species has previously been reported only from Guatemala on *Vernonia patens*. Of the collections reported above, only the one from Ecuador is on the type host. The collections on *V. paludosa* are referred here provisionally. The urediniospores are smaller and the markings more closely echinulate. The teliospore wall is lighter colored and the markings are often

absent in the lower part of the spore. One collection (1757) shows old primary uredinia, indicating the same life history as *P. inaequata*, and we hesitate to separate it. The collections on *V. Westiniana* also have smaller urediniospores, but the telia are remarkably like those of the type collection.

The species may be separated from all others on *Vernonia* by the small teliospores having evident verrucose-rugose markings on the wall.

356. *PUCCINIA LORENTZII* P. Henn. Hedwigia **35**: 239. 1896.

*Vernonia scorpioides* (Lam.) Pers. Rio de Janeiro, Brazil, Aug. 9, 1921, 1004; Fonseca, Nictheroy, Brazil, Sept. 18, 1921, 1122; Petropolis, Rio de Janeiro, Brazil, Oct. 18, 1921, 1228; São Paulo, Brazil, Jan. 23, 1922, 1493.

*Vernonia scorpioides sororia* (DC.) Baker, Reserva Florestal, Itatiaia, Rio de Janeiro, Brazil, May 8, 1922, 1825.

The collections listed bear uredinia only, and the spores are alike in all of them. *P. Lorentzii* has been recorded primarily from Brazil and Argentina on this host, and it has seemed best to refer the collections to that species for the present.

357. *Puccinia pertrita* Jackson & Holway, sp. nov.

II. *Uredosoris amphigenis*, plerumque hypophyllis, numerosis, sparsis, rotundatis, 0.3–0.5 mm. diam., cinnamomeo-brunneis, tardius nudis, pulverulentis, epidermide rupta cinctis; uredosporis globosis, 22–26  $\mu$  diam.; tunica cinnamomeo-brunnea, 1.5–2  $\mu$ , minute crebreque echinulata; poris 4–6, sparsis.

III. *Teleutosoris uredosoris conformibus*, atro-brunneis; teleutosporis late ellipsoideis vel oblongis, 30–36  $\times$  45–60  $\mu$ , infra rotundatis, supra rotundatis vel umbonatis, plerumque septo leniter constrictis; tunica obscure castaneo-brunnea, 3–5  $\mu$  cr., supra poros ad 6–8  $\mu$  umbone pallidiore incrassata, obscure verrucoso-rugosa, apparenter tereti, pedicello hyalino brevi deciduo praedita.

*Vernonia cognata* Less. Summit of Jaragua, near Taipas, São Paulo, Brazil, Feb. 19, 1922, 1572; Villa Prudente, São Paulo, Brazil, June 9, 1922, 1944.

*Vernonia lessingioides* Sch. Bip. Santa Anna, São Paulo, Brazil, May 28, 1922, 1901 (type).

*Vernonia* sp. Campos do Jordão, São Paulo, Brazil, Apr. 27, 1922, 1778.

Separable from other species on *Vernonia* by the large thick walled teliospores, the walls of which are essentially smooth, and large globose urediniospores with scattered pores and with walls nearly colorless, thin and finely and closely echinulate. The species differs from our interpretation of *P. vernoniphila* Speg. in urediniospore characters and from *P. pinguis* in the essentially smooth teliospore walls.

358. ***Puccinia pestibilis*** Jackson & Holway, sp. nov.

O. Pycnidii epiphyllis, paucis, dense aggregatis, punctiformibus, ampullaceis, profunde insidentibus,  $105-120\ \mu$  latis,  $120-150\ \mu$  altis; periphysibus brevibus.

I. Aecidiis epiphyllis, dense gregariis, pycnidia circumdantibus, paucis, parvis; peridio conspicue adulto, lacerato, albo; cellulis peridialibus e facie irregulariter polygonis,  $20-28 \times 45-60\ \mu$ ; tunica prominenter verrucoso-rugosa; aecidiosporis late ellipsoideis,  $20-24 \times 30-36\ \mu$ , pariete incolori  $1.5-2\ \mu$  cr. prominenter verrucoso-tuberculato praeditis.

II. Uredosoris hypophyllis, sparsis, rotundatis,  $0.5-0.8$  mm. diam., mox nudis, pallide cinnamomeo-brunneis, pulverulentis, epidermide rupta inconspicuis; paraphysibus praesentibus, inconspicuis, paucis, hyalinis vel leniter tinctis, rectis vel curvatis,  $12-15 \times 40-50\ \mu$ , tunica uniformiter tenui praeditis; uredosporis obovatis  $22-27 \times 28-34\ \mu$ ; tunica,  $1.5-2.5\ \mu$  cr., hyalina vel pallide aurato-brunnea, sparsius prominenterque echinulata; poris obscuris, 4-6, sparsis.

III. Teleutosoris hypophyllis, sparsis vel gregariis, parvis, rotundatis,  $0.2-0.5$  mm. diam., mox nudis, castaneo-brunneis, germinando cinerascens, pulvinatis; epidermide rupta inconspicua; paraphysibus uredosoris conformibus; teleutosporis late ellipsoideis vel obovatis,  $23-30 \times 50-80\ \mu$ , supra rotundatis vel obtusis, infra rotundatis vel angustatis, septo leniter constrictis; tunica lateribus tenui,  $1-1.5\ \mu$ , pallide cinnamomeo-brunnea, septo cellulae inferioris et apice ad  $4-10\ \mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Vernonia oppositifolia* Less. Rio de Janeiro, Brazil, Aug. 14, 1921, 1036; Therezopolis, Rio de Janeiro, Brazil, Sept. 29, 1921, 1168; Petropolis, Brazil, Oct. 20, 1921, 1233 (type).

This species is one of a group having light colored, smooth teliospore walls, thickened at the apex. It differs from *P. fundata* in the character of the markings of the urediniospores and from *P. depraveana* in aeciospore characters, and in the absence of

conspicuous paraphyses. The latter are present, but very poorly developed.

359. PUCCINIA ROTUNDATA Dietel, Hedwigia 36: 32. 1897.

*Puccinia rugosa* Speg. Ann. Soc. Cient. Argent. 17: 92. 1884.  
(Not Billings 1871.)

*Vernonia ferruginea* Less. Bello Horizonte, Minas Geraes, Brazil, Nov. 23, 1921, 1327; Sabará, Minas Geraes, Brazil, Dec. 2, 1921, 1363.

*Vernonia missionis* Gardn. Rio de Janeiro, Brazil, Aug. 12, 1921, 1024.

*Vernonia petiolaris* DC. Cantareira, São Paulo, Brazil, May 30, 1922, 1920.

*Vernonia petiolaris appendiculata* Baker, Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 6, 1922, 1809.

*Vernonia Westiniana* Less. São Paulo, Brazil, Jan. 26, 1921, 1501; Campos do Jordão, São Paulo, Brazil, Apr. 23, 1922, 1760.

*Vernonia* sp. Alta Boa Vista, Rio de Janeiro, Sept. 17, 1921, 1119; Fonseca, Nictheroy, Rio de Janeiro, Brazil, Sept. 18, 1921, 1125; Campo Grande, Rio de Janeiro, Brazil, Sept. 19, 1921, 1130; Therezopolis, Rio de Janeiro, Brazil, Sept. 28, 1921, 1162, 1165; Petropolis, Rio de Janeiro, Brazil, Oct. 18, 1921, 1229; Ouro Preto, Minas Geraes, Brazil, Dec. 7, 1921, 1370; Barbacena, Minas Geraes, Brazil, Dec. 12, 1921, 1386; Novo Friburgo, Rio de Janeiro, Brazil, Jan. 2, 1922, 1442; Alto da Serra, São Paulo, Brazil, Jan. 28, 1922, 1507.

This characteristic micro-form seems to have a wide distribution in South America, and is also known from Costa Rica and Panama.

360. PUCCINIA SEMIINSCULPTA Arth. Bot. Gaz. 40: 204. 1905.

*Bullaria semiinsculpta* Arth. & Mains, N. Am. Fl. 7: 498. 1922.

*Vernonia barbanoides* Less. Villa Prudente, São Paulo, Brazil, June 5, 1922, 1943.

*Vernonia obscura* Less. Mandaque, São Paulo, Brazil, May 25, 1922, 1890; Mogy das Cruzes, São Paulo, Brazil, July 4, 1922, 2002.

The collections listed seem best referred to *P. semiinsculpta* for the present. All the collections bear telia only, which are chiefly epiphyllous. The spores correspond very closely with the thick walled form of this species. Only a few urediniospores were found, which seem to conform with the description. The species has hitherto been known only from Mexico.

361. *Puccinia veniabilis* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis, in maculis parum decoloratis crebre gregariis, punctiformibus, profunde insidentibus, ellipsoideis, 75–90  $\mu$  latis, 100–135  $\mu$  altis; periphysibus brevibus.

I. Aecidiis hypophyllis, singulatim vel in greges 2–4 dispositis, pycnidiis contrappositis; peridio conspicue adulto, albo, membranaceo, breviter, cylindraceo vel saccato; margine lacerato; loculis peridialibus e facie polygonis, 20–30  $\times$  45–60  $\mu$ , tunica tenui minute verrucosa praeditis; aecidiosporis ellipsoideis 20–24  $\times$  28–36  $\mu$ ; tunica hyalina vel pallide aurato-brunnea, 1.5–2  $\mu$  cr., valde verrucoso-tuberculata, saepe striata, dein finem versus rugoso-striata.

II. Uredosoris non visis; uredosporis in teleutosoris globosis, 22–28  $\mu$  latis; tunica 1.5–2.5  $\mu$  cr., pallide cinnamomeo-brunnea, moderate valdeque echinulata; poris obscuris, 3–4, sparsis.

III. Teleutosoris hypophyllis, sparsis vel gregariis, parvis, rotundatis, 0.2–0.4 mm. diam., mox nudis, compactis, pulvinatis, primum castaneo-brunneis, deinde germinatione cinereis; paraphysibus copiosis, conspicuis, soro circumdantibus, valde arcuatis, septatis 2–3, 12–15  $\times$  60–100  $\mu$ , apice obtuso; tunica cinnamomeo-brunnea, exteriore 5–8  $\mu$  cr., interiore 1–1.5  $\mu$ ; teleutosporis cylindraceis, 17–24  $\times$  60–100  $\mu$ , basi rotundatis vel truncatis, apice rotundatis vel saepius acutis, septo non vel leniter constrictis; tunica cinnamomeo- vel pallide castaneo-brunnea, 1–1.5  $\mu$  cr., angulis cellulae inferioris visibiliter et apice magnopere ad 15  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Vernonia* sp. Therezopolis, Rio de Janeiro, Brazil, Oct. 4, 1921, 1189 (type); Santo Amaro, São Paulo, Brazil, March 16, 1922, 1639; May 27, 1922, 1894; Bosque da Saude, São Paulo, Brazil, May 27, 1922, 1896.

A very distinct species among *Vernonia* rusts, characterized

by the long narrow teliospores, greatly thickened at the apex, and the strongly developed, thick walled, incurved paraphyses. The thickening at the apex of the teliospore wall is usually much stronger on one side of the germ pore.

362. *PUCCINIA VERNONIPHILA* Speg. Ann. Mus. Buenos Aires 19: 306. 1909.

*Vernonia glabrata* Less. Santo Amaro, São Paulo, Brazil, March 16, 1922, 1637, May 27, 1922, 1895.

*Vernonia squarrosa* Less. Santa Anna, São Paulo, Brazil, May 28, 1922, 1898.

*Vernonia* sp. Mandaque, São Paulo, Brazil, May 25, 1922, 1885.

*Puccinia Vernoniophila* Speg. was based on a collection made at Buenos Aires, Argentina, on *Vernonia flexuosa*. Telia only were described. We have examined a portion of the type collection and can find no urediniospores. The aspect, however, is not that of a micro-form.

The above listed collections are assigned to this species with some hesitation, and the identification is tentative. Uredinia are present in our material. The urediniospores are globoid, 22-28  $\mu$  in diameter, the wall is minutely and closely echinulate, 2-3  $\mu$  thick, and the pores are 4-6 scattered. The teliospores agree very well with those in the type collection, although in No. 1898 they are somewhat more regular and broader with the wall slightly thicker and more prominently marked. Until other collections from the type locality are available, the exact status of this species must remain in doubt.

#### SPECIES ON CARDUACEAE

##### (Tribe Eupatorieae)

363. *AECIDIUM AMPLIATUM* Jackson & Holway; Arth. Mycologia 10: 148. 1918.

*Eupatorium lasiophthalmum* Griseb. Cochabamba, Bolivia, March 11, 1920, 396.

This collection seems best referred to this species for the present, though differing slightly in spore size and character of peridial cells. It is too close to justify separation. The type

collection was made at El Alto, Cartago, Costa Rica, Jan. 16, 1916, by Holway (434), and has not been reported elsewhere.

364. *Aecidium minimum* Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis, profunde insidentibus, punctiformibus, in maculis decoloratis dense gregariis, globosis vel ellipsoideis  $90-120 \times 90-120 \mu$ ; periphysibus brevibus.

I. Aecidiis hypophyllis, numerosis, dense gregariis, in greges 5-8 mm. diam. maculis decoloratis saepe purpurascensibus insidentibus, parvis, rotundatis,  $200-275 \mu$  diam., cupulatis, peridio pallide flavo et margine revoluto lacerato praeditis; cellulis peridialibus e latere rhomboideis,  $12-16 \times 28-34 \mu$ , subforte imbricatis; tunica exteriore  $2.5-4 \mu$  cr., levi, interiore  $2-2.5 \mu$ , crebre prominenterque verrucosa; aecidiosporis subglobosis,  $12-15 \mu$  diam., tunica hyalina  $1 \mu$  minusve cr. tenuiter crebreque verrucosa praeditis.

*Stevia urticaefolia* Thunb. Ouro Preto, Minas Geraes, Brazil, Dec. 6, 1921, 1366 (type); Hacienda La Florida, Sur Yungas, Bolivia, May 27, 1920, 665.

This *Aecidium* is very much like the aecial stage of *Puccinia Eleocharidis* Arth., which occurs on species of *Eupatorium*. The aeciospores in our specimens are, however, noticeably smaller. Since the diplont of *P. Eleocharidis* has not with certainty been reported from South America, we hesitate to record it under that species.

365. *CHRYSOCYCLUS MIKANIAE* (Arth.) Sydow, Ann. Myc. 23: 324. Dec. 31, 1925.

*Puccinia subandina* Lagerh. ined. (Not Speg. 1902.)

*Chrysopsora Mikaniae* Arth. Bull. Torrey Club 51: 54. 1924.

*Holwayella Mikaniae* Jackson, Mycologia 18: 49. Jan. 1, 1926.

*Mikania buddleiaefolia* DC. San Felipe, Sur Yungas, Bolivia, May 21, 1920, 637; Therezopolis, Rio de Janeiro, Brazil, Sept. 28, 1921, 1159 (type).

*Mikania Lindbergii* Bak. Mandaque, São Paulo, Brazil, May 25, 1922, 1884; Tremembé, São Paulo, Brazil, May 30, 1922, 1910.

The Brazilian collection on *Mikania buddleiaefolia* is the type of this interesting species. In this collection the two celled

*Puccinia*-like stage is of short duration, while in the Bolivian material an evident two celled stage is developed. It is possible that more than one species occurs on *Mikania*, but at this time we hesitate to attempt a separation of the material. A specimen labelled *Puccinia subandina* Lagerh. n. sp., collected by Lagerheim, Oct. 1891, in Ecuador, is in the Arthur Herbarium, and is similar to the Bolivian collection recorded above. The name seems never to have been published.

366. **Cionothrix andina** (Lagerh.) Jackson & Holway, comb. nov.  
*Cronartium andinum* Lagerh. Sydow, Monog. Ured. 3: 581.  
1915.

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*Eupatorium Pseudochila* Benth. Quito, Ecuador, Aug. 16,  
1920, 906.

A characteristic species apparently previously known only from the type collection made by Lagerheim at Pichincha, Ecuador. The telial columns in this species are broader, the color darker and the spores considerably larger than in the more common *C. praelonga*.

367. **CIONOTHRIX PRAELONGA** (Wint.) Arth. N. Am. Fl. 7: 124.  
1907.  
*Cronartium praelongum* Wint. Hedwigia 26: 24. 1887.

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*Eupatorium subscandens* Hieron. El Chaco, Sur Yungas,  
Bolivia, May 25, 1920, 646.

*Eupatorium* sp. Ouro Preto, Minas Geraes, Brazil. Dec. 9,  
1921, 1373; São João, São Paulo, Brazil, Apr. 13, 1922,  
1729.

368. **PUCCINIA CONOCLINII** Seym.; Burrill, Bot. Gaz. 9: 191.  
1884.  
*Uredo Agerati* Mayor, Mém. Soc. Neuch. Sci. Nat. 5: 595.  
1913.

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*Ageratum conyzoides* L. Huigra, Chimborazo, Ecuador, Aug.  
6, 1920, 851; Hacienda La Florida, Sur Yungas, Bolivia,  
May 26, 1920, 658; Hacienda Anacuri, Nor Yungas,  
Bolivia, June 5, 1920, 723.



- Eupatorium Bridgesii* Rob. Cochabamba, Bolivia, March 7, 1920, 373.
- Eupatorium pseudoriganoides* Hieron. Cuenca, Azuay, Ecuador, Sept. 15, 1920, 993.
- Eupatorium Solidaginis* H.B.K. Huigra, Chimborazo, Ecuador, Aug. 5, 1920, 845.
- Eupatorium urubambense* Rob. Urubamba Valley, Peru, July 3, 1920, 759.
369. PUCCINIA EUPATORII Dietel, Hedwigia 36: 32. 1897.
- Eupatorium betonicaeforme* (DC.) Bak. Summit of Jaraguá, Near Taipas, São Paulo, Brazil, Feb. 19, 1922, 1573; São Caetano, São Paulo, Brazil, Feb. 22, 1922, 1586.
- Eupatorium macrocephalum* Less. Arthur Anvim, São Paulo, Brazil, March 15, 1922, 1632; Santa Anna, São Paulo, Brazil, Feb. 22, 1922, 1588; Campinas, São Paulo, Brazil, Apr. 5, 1922, 1701; Lapa, São Paulo, Brazil, March 3, 1922, 1606.
- Eupatorium pumilum* (Gardn.) Rob. Campos do Jordão, São Paulo, Brazil, Apr. 24, 1922, 1764.
- Eupatorium purpurascens* Sch. Bip. Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 7, 1922, 1821; Garulhos, São Paulo, Brazil, June 1, 1922, 1928; Santa Amaro, São Paulo, Brazil, June 26, 1922, 1984.
- Eupatorium* sp. Santa Amaro, São Paulo, Brazil, June 26, 1922, 1982; Mandaque, São Paulo, Brazil, May 25, 1922, 1892.
- Originally reported from Serra Geral, Brazil on *Eupatorium macrocephalum*, this species is also known from Uruguay, Argentina, Colombia and Trinidad.
370. PUCCINIA EUPATORII-COLUMBIANI Mayor, Mém. Soc. Neuch. Sci. Nat. 5: 514. 1913.
- Eupatorium adenanthum* DC. Petropolis, Brazil, Oct. 20, 1921, 1236.
- Eupatorium inulaefolium* H.B.K. Nictheroy, Rio de Janeiro, Brazil, Dec. 27, 1921, 1428; Botanical Garden, São Paulo Museum, São Paulo, Brazil, March 13, 1922, 1626; Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 7, 1922, 1816.

*Eupatorium inulaefolium suaveolens* (H.B.K.) Hieron. Hacienda Anacuri, Nor Yungas, Bolivia, June 3, 1920, 704; Hacienda La Florida, Sur Yungas, Bolivia, May 28, 1920, 670.

*Eupatorium* sp. Guaruja, São Paulo, Brazil, June 12, 1922, 2007; Raiz da Serra, Petropolis, Brazil, Nov. 6, 1921, 1279; Jacarépaguá, Rio de Janeiro, Brazil, Nov. 16, 1921, 1311.

A characteristic species originally reported on *Eupatorium columbianum* from Colombia. It has also been reported from Trinidad on *E. inulaefolium*.

371. *PUCCINIA HORRIDA* Lagerh.; Pat. & Lagerh. Bull. Soc. Myc. Fr. 11: 214. 1895.

*Eupatorium cacalioides* H.B.K. Cuenca, Azuay, Ecuador, Sept. 10, 1920, 970.

This very characteristic species seems not to have been reported except from the type locality at Guaranda, Ecuador.

372. *Puccinia Mikaniae* Jackson & Holway, sp. nov.

O. Pycnidiis non visis.

I. Aecidiis hypophyllis, in greges 2-3 mm. diam. laxe gregariis, parvis, cupulatis, peridio flavescenti et margine revoluti vel eroso praeditis; cellulis peridialibus e latere rhomboideis, 14-16  $\times$  28-32  $\mu$ , subforte imbricatis; tunica exteriori 4-6  $\mu$  cr., transverse striata, interiori 2-3  $\mu$ , minute crebreque verrucosa; aecidiosporis angulato-globosis, 15-18  $\mu$  diam., tunica hyalina 1  $\mu$  minute verrucosa praeditis.

III. Teleutosoris hypophyllis, inter vel circum aecidia dispositis, crebre gregariis et plus minusve in greges 2-5 mm. diam. confluentibus, tarde nudis, nigrescentibus, compactis, applanatis, epidermide diu tectis, compositis; omni soro stromate obscuro et e cellulis crasse tunicatis elongatisque constituto secernato; teleutosporis parum angulato-clavatis vel cylindraceis, 12-15  $\times$  30-48  $\mu$ , supra rotundatis vel obtusis, infra pedicellum versus plerumque contractis, non vel leniter constrictis; tunica castaneo-brunnea, 1.5-2  $\mu$  cr., apice ad 3-6  $\mu$  incrassata, levi; pedicello sporam dimidiam aequante vel breviori, hyalino vel tunicae sporarum concolori.

*Mikania Argyreiae* DC. Rio de Janeiro, Brazil, Aug. 10, 1921, 1015 (type).

*Mikania buddleiaefolia* DC. Rio de Janeiro, Brazil, Aug. 9, 1921, 1003.

*Mikania* sp. City Park, Bello Horizonte, Minas Geraes, Brazil, Nov. 21, 1921, 1322.

This -opsis form is of the type of *Puccinia tenuis* (Schw.) Burrill. No pycnia could be found. It is entirely possible that this is the same as *Aecidium Mikaniae* P. Henn., originally described from near Blumenau, Santa Catharina, Brazil, on *Mikania confertifissima*. Specimens of the type have, however, not been available.

373. *Puccinia mikanifolia* Jackson & Holway, sp. nov.

O. Pycnidiis non visis, verisimiliter carentibus.

III. Teleutosoris hypophyllis, crebre gregariis, in greges parvos 1-1.5 mm. diam. dispositis, maculis decoloratis insidentibus, parvis, rotundatis, 0.2-0.4 mm. diam., saepe confluentibus, mox nudis, castaneo-brunneis, ob germinationem parum cinerascentibus, compactis, pulvinatis, epidermide rupta non visibili; teleutosporis parum irregulariter clavatis vel cylindraceis,  $9-12 \times 28-45 \mu$ , supra rotundatis vel obtusis, plerumque infra contractis, septo leniter constrictis; tunica cinnamomeo-brunnea, tenui  $1 \mu$  minusve, apice conspicue crassata ad  $3.5-6.5 \mu$ , levi; pedicello hyalino, sporam aequante vel brevior.

*Mikania* sp. Pico, Itatiaya, Rio de Janeiro, Brazil, May 18, 1922, 1856.

This species appears to be quite distinct from *P. Spegazzinii*. The spores are shorter and narrower, and considerably more thickened at the apex. The sori are dark chestnut-brown.

374. *Puccinia Piqueriae* Jackson & Holway, sp. nov.

O. Pycnidiis non visis, verisimiliter carentibus.

III. Teleutosoris difformibus alteris germinativis, hypophyllis sed quandoque epiphyllis, singulatim vel gregatim dispositis et in maculis subhypertrophicis decoloratis confluentibus, rotundatis, 0.4-1.0 mm. diam., mox nudis, primum cinnamomeo-brunneis, dein cinereis, compactis, pulvinatis, epidermider upta inconspicuis; alteris conquiscentibus hypophyllis singulatim dispositis vel quandoque confluentibus, 0.5-1.0 mm. diam., illis quandoque circumdantibus, obscure castaneo-brunneis, tarde nudis, compactis, pulvinatis; epidermide rupta cinctis; illorum teleutosporis clavatis vel cylindraceis,  $12-15 \times 30-45 \mu$ , supra rotundatis, infra truncatis et subangustatis, septo leniter vel non constrictis; tunica hyalina,

tenui,  $1\ \mu$  minusve, apice  $3\text{--}5\ \mu$  incrassata, levi; pedicello brevi, forti, hyalino: horum teleutosporis clavatis, quandoque cylindraceis, supra rotundatis vel obtusis, pedicellum versus attenuatis, septo leniter vel non constrictis; tunica castaneo-brunnea,  $1\text{--}1.5\ \mu$  cr., apice incrassata  $4\text{--}9\ \mu$ , levi; pedicello sporam dimidiam aequante vel plerumque brevior, hyalino vel tunicae sporarum ritu tincto.

*Piqueria peruviana* (Gmel.) Rob. Huigra, Chimborazo, Ecuador, Aug. 2, 1920, 808 (type), 809; Hacienda del Urco, Urubamba Valley, Cuzco, Peru, July 4, 1920, 765.

In this micro-form the three collections form an interesting series. Collection 809 bears exclusively the lepto-form, while collection 765 bears only the dark sori of the micro-form. In collection 808, however, the dark sori of the resting form are commonly found surrounding the old sori of the germinating form. The description is drawn from all three collections, with No. 808 designated as the type.

375. PUCCINIA SPEGAZZINII DeToni, in Sacc. Syll. Fung. 7: 704. 1888.

*Puccinia australis* Speg. Anal. Soc. Ci. Argent. 10: 8. 1880 (Not Körn. 1876).

*Mikania* sp. Huigra, Chimborazo, Ecuador, Aug. 3, 1920, 816; Campo Grande, Rio de Janeiro, Brazil, Sept. 19, 1921, 1128; Therezopolis, Rio de Janeiro, Brazil, Oct. 14, 1921, 1217; Jacarépaguá, Rio de Janeiro, Brazil, Nov. 16, 1921, 1313; Nictheroy, Rio de Janeiro, Brazil, Dec. 27, 1921, 1429; Ypiranga, São Paulo, Brazil, Feb. 23, 1922, 1592.

376. PUCCINIA TOLIMENSIS Mayor, Mém. Soc. Neuch. Sci. Nat. 5: 516. 1913.

*Eupatorium glutinosum* Lam. Quito, Ecuador, Aug. 19, 1920, 926.

*Stevia* sp. Sorata, Bolivia, Apr. 18, 1920, 542.

The collection of *Eupatorium glutinosum* is not typical of this rust species. The sori are blackish brown, not germinating, and the spore wall is dark chestnut-brown, greatly thickened at the

apex. The teliospores are somewhat broader and longer than is usual for the species, reaching  $70\ \mu$  in length. The collection might be made the basis of an undescribed species, but it seems best for the present to interpret it as a micro-condition of a species usually found in the lepto-phase. The species is known on *Eupatorium* from Colombia, Guatemala and from an isolated locality in New York.

While this species has not previously been reported on *Stevia*, there seems to be no reason why the collection listed above should not be assigned to it.

377. PUCCINIOSIRA EUPATORII Lagerh. Arth. Am. Jour. Bot. 5: 435. 1918.

*Eupatorium glechonophyllum* Less. Quito, Ecuador, Aug. 21, 1920, 935.

*Eupatorium* sp. Cuenca, Ecuador, Sept. 15, 1920, 988.

The two collections listed are recorded under this name since it would seem to be an open question whether this rust is the same as *Baeodromus Eupatorii* Arth., with which Arthur includes it in the N. Am. Flora (7: 700). The sori are larger and unaccompanied by pycnia. The structure is very difficult to determine, and the rust may not be a *Pucciniosira*. The type of the species was made at Tichincha, Ecuador, by Lagerheim, in 1892.

#### SPECIES ON CARDUACEAE

##### (Tribe Astereae)

378. AECIDIUM ERIGERONTIS Kern & Whetzel, Jour. Dept. Agr. Porto Rico 14: 342. 1930.

*Erigeron bonariensis* L. Bello Horizonte, Minas Geraes, Brazil, Nov. 30, 1921, 1350.

*Erigeron* (Near *E. laxiflorus* Baker) Ouro Preto, Minas Geraes, Brazil, Dec. 8, 1921, 1371.

*Erigeron* sp. Huigra, Chimborazo, Ecuador, Aug. 3, 1920, 826.

These collections bear aecidia with aeciospores having the appearance of being thickened at the apex. The rust agrees well with the description, except that we find no spores as long as  $31\ \mu$ .

The rather prominent verrucose markings often appear to be deciduous, leaving smooth areas, particularly near the unthickened end.

379. *AECIDIUM SPEGAZZINII* DeToni, in Sacc. Syll. Fung. 7: 802. 1888.

*Aecidium australe* Speg. Anal. Soc. Ci. Argent. 17: 125. 1884  
(Not *A. australe* Berk. 1843).

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*Erigeron bonariensis* L. San Felipe, Sur Yungas, Bolivia,  
May 19, 1920, 618.

There would appear to be two species of *Aecidium* on *Erigeron bonariensis* in South America. This one has aeciospores with no appearance of thickening at one end and with the walls so finely verrucose as to appear smooth. The aecia are somewhat larger than in the collections referred to *A. Erigerontis*. We have not seen the type of *A. Spegazzinii*, but the collections seem best referred to that species for the present. It has been previously reported from Argentina, Brazil and Colombia. It seems quite possible that some of these reported collections may prove to be *A. Erigerontis*.

380. *PUCCINIA CONYZAE* P. Henn. Hedwigia 35: 239. 1896.

*Puccinia Baccharidis-triplinervis* P. Henn. Hedwigia 35: 241. 1896.

*Puccinia sordida* Dietel, Hedwigia 36: 31. 1897.

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*Conyza triplinervia* Less. Therezopolis, Rio de Janeiro, Brazil, Sept. 30, 1921, 1175; Ouro Preto, Minas Geraes, Brazil, Dec. 6, 1921, 1367; Barbacena, Minas Geraes, Brazil, Dec. 12, 1921, 1381; Novo Friburgo, Rio de Janeiro, Brazil, Jan. 3, 1922, 1451; Guarulhos, São Paulo, Brazil, Jan. 30, 1922, 1516; Campos do Jordão, São Paulo, Brazil, Apr. 20, 1922, 1736.

We have little hesitancy in assigning all these collections to the above species, which was originally described on the same host and from the same general region. The species is evidently common, but not known from other sections of South America. In our specimens the urediniospores may be 30  $\mu$  long, and the

teliospores are often narrower than given in the original description.

*Puccinia Baccharidis-triplinervis* P. Henn. is included as a synonym partly on the authority of Dietel (Ann. Myc. 12: 87. 1914). I have examined one of the two collections cited by Hennings (Ule 1449). The rust on this collection corresponds closely to that on the collections listed above.

381. *PUCCINIA DOLORIS* Speg. Anal. Soc. Ci. Argent. 12: 68. 1881.

*Erigeron hirtellus* DC. Papudo, Chile, Sept. 17, 1919, 36; Sept. 19, 1919, 49.

A distinct microcyclic species described originally from near Dolores, Argentina, and otherwise reported only from Colombia.

382. *Puccinia Heterothalami* Jackson & Holway, sp. nov.

O, I. Pycnidiis et aecidiis praesentibus (*vide infra*).

II. Uredosoris amphigenis, sparsis, magnitudine variabilibus, 0.2–1.0 mm. diam., tarde nudis, subflavis, pulverulentis, epidermide irregulariter rumpente diu tectis; uredosporis ellipsoideis vel obovatis,  $18\text{--}22 \times 24\text{--}30 \mu$ ; tunica hyalina,  $1\text{--}1.5 \mu$ , crebre minuteque echinulato-verrucosa, poris obscuris praedita.

III. Teleutosoris uredosoris conformibus, plerumque 0.3–0.5 mm. diam., castaneo-brunneis, compactis, subpulvinatis; teleutosporis parum irregulariter ellipsoideis, oblongis vel obovatis,  $26\text{--}32 \times 38\text{--}45 \mu$ , supra rotundatis, infra rotundatis vel quandoque subangustatis, septo non vel lentissime constrictis; tunica aurato- vel pallide castaneo-brunnea, crassitudine variabili,  $1.5\text{--}3 \mu$ , apice late ad  $6\text{--}9 \mu$  et lateribus infra septum cellulae inferioris valde incrassata, levi; pedicello hyalino, flexuoso, sporam aequante vel brevior sed quandoque eam super.

*Heterothalamus boliviensis* Wedd. La Paz, Bolivia, Apr. 3, 1920, 493.

Old aecia accompanied by pycnia are present but too few to admit of accurate diagnosis. The aecia are caeomoid, large, 1 mm. in diameter, rupturing irregularly, spore mass whitish. The aeciospores are subglobose or ellipsoid,  $21\text{--}24$  by  $24\text{--}30 \mu$ , with thin, colorless walls  $1\text{--}1.5 \mu$ , finely and closely verrucose, the markings not arranged in lines.

While obviously of similar type to the rusts occurring on *Bac-*

*charis*, this species seems amply distinct, and occurs on a host genus on which no rust species have previously been reported.

#### ON THE GENUS *BACCHARIS*

Professor Holway obtained a most remarkable collection of *Baccharis* rusts in South America, consisting of over one hundred numbers. A great deal of time has been devoted to their study, and most of them are here reported. It became evident early in the work that a considerable number of apparently undescribed species were represented in the material. A great deal of difficulty has been encountered in separating them because of the inadequacy of many of the old descriptions. One of the most important characters in this group of rusts is the nature of the markings of the aeciospore wall, and these have often been poorly described. Fortunately, a considerable number of the type collections of species previously described has been available during the period in which this study has been made. The Arthur herbarium, at Purdue University, was consulted during June and July, 1931, and more recently the entire collection of *Baccharis* rusts in the Holway herbarium has been made available through the courtesy of Mrs. Mary M. Holway. Professor H. H. Whetzel, of Cornell University, has loaned me the types of Mayor's species, as well as the Colombian collections made by Chardon and Toro.

Twenty-six species of *Puccinia* occurring on *Baccharis* have previously been reported. Most of these appear to be distinct. In the Holway collections from South America we have encountered eighteen that seem to be different. These are described in the following pages. It has seemed desirable to furnish a key in order to indicate the basis on which the species described as new have been separated. Since comparative characters and spore size have of necessity been used frequently in the key, a number of species will be found in more than one place.

One of the interesting results of this study is that a series of seven species has been brought to light, which have deep seated, epiphyllous aecia, without peridia and with the aeciospore walls definitely and often strongly echinulate. Only one of these species, *P. Baccharidis-rhexioides* Mayor, has been previously recognized.



It should, perhaps, be explained why the genus *Eriosporangium* has not been used. It has seemed to the writer that this genus is not a natural one, and that it is impracticable to attempt to separate it from *Puccinia*. It is true that the greater number of the species occurring on *Baccharis* have caeomoid aecia. If, however, a range of hosts in the Carduaceae is considered, every gradation can be found, from the caeomoid type of aecium, as found in the rusts on *Baccharis*, to the aecidioid aecium of the typical *Puccinia*. As to the teliospores, many species having typical aecidioid aecia are known to have teliospores with thin, light colored walls, which germinate at once. There are species known which occur on *Vernonia* and *Ilyptis* in which two sorts of teliospores occur, thin, light colored spores germinating at once, and dark, thick walled resting spores. We do not feel that anything is to be gained by attempting a separation of a genus on these bases.

## KEY TO SPECIES OF PUCCINIA ON BACCHARIS

- Teliospore wall thick, conspicuously roughened..... 395. *P. impolita*.
- Teliospore wall usually thin, smooth or rarely punctate.
- Teliospore wall not conspicuously thickened above, thin, light colored.  
(Species with apices slightly thickened 2.5–4  $\mu$  are included here.)
- Teliospores averaging less than 50  $\mu$  long.
- Teliospores more than 25  $\mu$  wide.. *P. praeandina* Speg.
- Teliospores less than 25  $\mu$  wide.
- All spore forms present; euforms.
- Aeciospore wall finely echinulate..... *P. Baccharidis-rhexioides*.
- Aeciospore wall verrucose or rugose.
- Aeciospore wall rugose or verrucose rugose in lines.
- Urediniospores 20–24  
by 24–30  $\mu$ ..... *P. exornata*.
- Urediniospores 18–20  
by 21–26  $\mu$ ..... 396. *P. improcera*.
- Aeciospore wall verrucose, not in lines..... *P. oaxacana*.

- Only teliospores known; micro-  
form..... 401. *P. perspicabilis*.
- Teliospores averaging over 50  $\mu$  long.  
Teliospore wall colorless.  
Teliospores averaging less than  
65  $\mu$  long.  
Uredinia unknown, aecio-  
spore wall verrucose in  
striae..... 394. *P. Henningsii*.
- Uredinia present, aeciospore  
wall verrucose, not in  
striae..... *P. Mayerhansii*
- Teliospores averaging over 65  $\mu$   
long..... 404. *P. praedicabilis*.
- Teliospore wall distinctly colored.  
Uredinia unknown.  
Aecia present; ?-opsis forms.  
Aeciospore wall finely  
verrucose in lines.  
Aeciospores 21-26 by  
26-30  $\mu$ ..... *P. Montoyae*.
- Aeciospores ellipsoid,  
30-40  $\mu$  long.  
Teliospores not or  
very slightly  
constricted,  
pedicel short.. *P. Baccharidis-cassinoides*.
- Teliospores strong-  
ly constricted,  
pedicel long... 399. *P. inopina*.
- Aeciospore wall strongly  
echinulate, 28-32 by  
32-45  $\mu$ ..... 383. *P. albula*.
- Aecia unknown; micro-form. 401. *P. perspicabilis*.
- Uredinia present.  
Urediniospore wall echinu-  
late.  
Urediniospore wall mod-  
erately and strongly  
echinulate..... *P. baccharidicola*.
- Urediniospore wall  
sparsely and finely  
echinulate; aeciospore  
wall echinulate..... 384. *P. alia*.
- Urediniospore wall verru-  
cose or verrucose ru-  
gose.  
Urediniospores (?) 19-22  
by 22-28  $\mu$ ..... *P. Baccharidis-cassinoides*.

- Urediniospores 22-27 by 32-48  $\mu$  ..... 402. *P. pervenusta*.
- Teliospore wall appreciably thickened above, 5  $\mu$  or more (a few species thickened 3-4  $\mu$  are repeated here).  
Teliospores averaging less than 45  $\mu$  long.  
Teliospores averaging more than 25  $\mu$  wide.
- Urediniospores unknown, aeciospores coarsely rugose ..... 403. *P. praeculta*.
- Urediniospores present, aeciospores when present not as above.  
Urediniospores finely and closely echinulate.  
Teliospore wall smooth.  
Teliospores 27-32 by 35-45  $\mu$  ..... *P. sphenica*.
- Teliospores 24-34 by 42-48  $\mu$  ..... 408. *P. unicolor*.
- Teliospore wall minutely punctate ..... *P. egressa*.
- Urediniospore wall strongly and sparsely echinulate, teliospore wall minutely punctate ..... *P. Baccharidis-histellae*.
- Teliospores averaging less than 25  $\mu$  wide.  
Urediniospores unknown, aeciospore wall coarsely ridged .. 403. *P. praeculta*.
- Urediniospores present, aeciospores when present not as above.  
Teliospores less than 18  $\mu$  broad.  
Apex of teliospore thickened, 6-12  $\mu$  ..... *P. pistórica*.
- Apex of teliospore slightly thickened, 3-4  $\mu$  .. 396. *P. improcera*.
- Teliospores more than 18  $\mu$  broad.  
Teliospore wall minutely punctate ..... *P. egressa*.
- Teliospore wall smooth.  
Pedicel long, persistent. Apex thickened 2-4  $\mu$  ..... *P. exonerata*.
- Pedicel usually short.

- Apex thickened  
3-4  $\mu$  . . . . . 396. *P. improcera*.
- Apex thickened  
4-7  $\mu$ .  
Urediniospores  
23-28 by  
30-40  $\mu$  . . . . . *P. Montserratensis*.
- Urediniospores  
22-24 by  
26-33  $\mu$  . . . . . 405. *P. praedicta*.
- Teliospores between 45 and 60  $\mu$  long.  
Teliospores averaging more than  
26  $\mu$  broad.  
Aeciospore wall coarsely and  
prominently tuberculate. . . . . 386. *P. Baccharidis-spartea*.
- Aeciospore wall finely verru-  
cose.  
Aeciospore wall markings  
not in lines. . . . . 392. *P. evadens*.
- Aeciospore wall markings in  
lines. . . . . 385. *P. Baccharidis*.
- Teliospores averaging less than 26  $\mu$   
broad.  
Teliospores thickened 6  $\mu$  or less  
at apex.  
Aeciospore wall echinulate. . . . . 398. *P. indagata*.
- Aeciospore wall densely and  
coarsely verrucose. . . . . *P. Montoyae*.
- Teliospores thickened 6  $\mu$  or  
more at apex.  
Pedicel long, persistent . . . . . *P. Baccharidis-cylindrica*.
- Pedicel usually no longer  
than spore.  
Urediniospores absent or  
unknown.  
Micro-form, telio-  
spore apex 6-12  $\mu$ . . . . . 397. *P. incomposita*.
- Opsis forms, telio-  
spore apex 5-  
9  $\mu$ .  
Aeciospore wall  
finely verru-  
cose-rugose. . . . . 390. *P. consulta*.
- Aeciospore wall  
coarsely ridged. . . . . 403. *P. praeculta*.
- Urediniospores present.  
Urediniospores  
strongly thickened  
at apex. . . . . *P. Baccharidis-multiflorae*.

- Urediniospores  
not appreciably  
thickened at  
apex.
- Urediniospore  
pores evident,  
8 scattered.... 385. *P. Baccharidis*.
- Urediniospore  
pores ob-  
scure.
- Urediniospores  
narrow, 16-  
20  $\mu$  wide... 406. *P. ruderaria*.
- Urediniospores  
more than  
20  $\mu$  wide.
- Uredinio-  
spores  
22-25 by  
24-27  $\mu$ . 389. *P. consueta*.
- Uredinio-  
spores  
23-26 by  
30-40  $\mu$ . 407. *P. salebrata*.
- Teliospores averaging more than 60  $\mu$   
long.
- Urediniospores absent or unknown;  
(?) -opsis and micro-forms.
- Teliospores averaging over 75  $\mu$   
long; micro-form..... 387. *P. caeomatiformis*.
- Teliospores averaging less than  
75  $\mu$  long; (?) -opsis forms.
- Aeciospore wall echinulate.
- Markings finely echinu-  
late, moderately  
spaced..... 399a. *P. interjecta*.
- Markings strongly and  
sparsely echinulate... 393. *P. expetiva*.
- Aeciospore wall not echinu-  
late.
- Side walls of teliospores  
2-3  $\mu$  thick..... 400. *P. perincerta*.
- Side walls of teliospores  
less than 1.5  $\mu$   
thick.
- Teliospore apex 3-4  $\mu$ ,  
aeciospore wall  
markings in rows.. 399. *P. inopina*.
- Teliospore apex thick-

ened 4-7  $\mu$ , aecio-  
spore wall mark-  
ings not in rows,  
prominently verru-  
cose tuberculate..

*P. Ancizari.*

Urediniospores present.

Wall of urediniospore brown,  
echinulate.

Urediniospore wall pores 4,  
equatorial.....

388. *P. chilensis.*

Urediniospore wall pores 6,  
in three bands.....

391. *P. cuzcoensis.*

Wall of urediniospore colorless,  
verrucose-rugose.....

402. *P. pervenusta.*

383. ***Puccinia albula*** Jackson & Holway, sp. nov.

O. Pycnidii epiphyllis, numerosis, sparsius gregariis, maculis flavidis gregatim insidentibus, aecidiis circumclusis, parvis, punctiformibus, flavidis, subglobosis vel subconicis, 120-135  $\times$  135-150  $\mu$ ; periphysibus columnam brevem efformantibus.

I. Aecidiis epiphyllis, circum pycnidia dispositis, profunde insidentibus, tarde nudis, poro irregulari apertis, soro flavescenti praeditis; aecidiosporis ellipsoideis vel subglobosis, 28-32  $\times$  32-45  $\mu$ ; tunica hyalina, 2.5-3.5  $\mu$  cr., crasse sparseque echinulata, acuminibus 3-6  $\mu$  inter se secernatis et 2-3  $\mu$  longis praedita.

III. Teleutosoris hypophyllis, sparsis vel gregariis, in maculis flavescentibus sitis, parvis, rotundatis, 0.2-0.3 mm. diam., mox nudis, compactis, dein pulvinatis, splendide aurato-brunneis, germinando cinerascentibus; epidermide fissa non visibili; teleutosporis ellipsoideis, oblongis vel subclavatis, 20-24  $\times$  48-68  $\mu$ , supra rotundatis, infra pedicellum versus rotundatis vel quandoque angustatis, ut plurimum septo valde constrictis; tunica flavescenti, tenui 1-1.5  $\mu$ , apice leniter vel non ad 2.5  $\mu$  incrassata, levi; pedicello hyalino, fragili, sporam aequante vel brevior.

*Baccharis* sp.<sup>¶</sup> Nictheroy, Rio de Janeiro, Brazil, Sept. 23, 1921, 1149.

This species is separable from others having aeciospores with echinulate wall markings, by the narrow teliospores, thickened only slightly at the apex, and the large, thick walled, very sparsely echinulate aeciospores.

Aecia unaccompanied by pycnia, for the most part epiphyllous, occasionally hypophyllous, are abundant in this material. They seem to be of the same structure as those with pycnia and the spores are the same. Telia are often found on the under side of the spots where these occur.

384. *Puccinia alia* Jackson & Holway, sp. nov.

O. I. Pycnidiis et aecidiis praesentibus, vetustis (*vide infra*).

II. Uredosoris hypophyllis, sparsis vel gregariis, quandoque circinatim dispositis, rotundatis vel irregulariter formatis, 0.3–0.8 mm. diam., tarde nudis, albidis vel flavescentibus, pulverulentis, epidermide fissa cinctis; uredosporis obovatis,  $18-24 \times 24-30 \mu$ ; tunica hyalina vel subflavida,  $1.5-2 \mu$  cr., minute sparseque echinulata, poris obscuris praedita.

III. Teleutosoris hypophyllis, sparsis vel gregariis, rotundatis, 0.3–0.6 mm. diam., nitide castaneo-brunneis, deinde germinatione cinereis, mox nudis, compactis, primum applanatis, dein pulvinatis; epidermide rupta ut plurimum non visibili; teleutosporis oblongo-cylindratis vel subclavatis,  $16-21 \times 45-65 \mu$ , supra rotundatis vel obtusis, infra pedicellum versus rotundatis vel angustatis, septo valde constrictis; tunica aurato-brunnea, tenui,  $1-1.5 \mu$ , apice leniter incrassata ad  $2.5-3.5 \mu$ , levi; pedicello hyalino, flexuoso, sporam aequante vel brevior.

*Baccharis trinervis* (Lam.) Pers. Rio de Janeiro, Brazil, Aug.

9, 1921, 1007 (type); Rio de Janeiro, Brazil, Aug. 25,

1921, 1072; Nictheroy, Rio de Janeiro, Brazil, Sept. 23,

1921, 1151.

This species forms one of a series of seven species having deep seated, epiphyllous aecia, without peridia, opening by a pore, and having aeciospores with definitely echinulate wall markings. These aecia, in all cases which we have examined, arise from below the palisade layer of leaf tissue.

The aecia in this species are too old to permit an adequate diagnosis. They are epiphyllous, deep seated, opening by a pore. The aeciospores are ellipsoid or subglobose,  $18-21$  by  $22-26 \mu$ , with colorless walls  $1.5-2 \mu$  thick, finely and sparsely echinulate. Epiphyllous pycnia accompany the aecia.

With the exception of *P. Baccharidis-rhexioides* Mayor, this is the only species we have encountered in this group having urediniospores. Our species is separable from that species by the small size of the aeciospores.

385. *PUCCINIA BACCHARIDIS* Dietel & Holway; Dietel, *Erythea* 1: 250. 1893.

*Baccharis Burchellii* Baker ? Varzea, Therezopolis, Rio de Janeiro, Brazil, Sept. 30, 1921, 1174.

*Baccharis Feuillei* DC. Choisica, Peru, July 22, 1920, 777.

*Baccharis floribunda* H.B.K. Huigra, Chimborazo, Ecuador, Aug. 4, 1920, 836.

*Baccharis glutinosa* Pers. Cuzco, Peru, July 1, 1920, 750.

*Baccharis marginalis* DC. Papudo, Chile, Sept. 16, 1919, 26.

*Baccharis* (Near *B. oxydonta* DC.) Therezopolis, Brazil, Sept. 29, 1921, 1172; Petropolis, Brazil, Oct. 30, 1921, 1259.

*Baccharis* sp. Riobamba, Ecuador, Aug. 10, 1920, 860; Quito, Ecuador, Aug. 13, 1920, 878, Aug. 23, 1920, 942; Therezopolis, Rio de Janeiro, Brazil, Sept. 28, 1921, 1164.

Collections with rather wide teliospores measuring between 45 and 65  $\mu$  long, and with walls only slightly thickened at the apex are included here, together with collections of uredinia with colored walls and scattered pores. Aeciospores, where present, have punctate-striate markings.

Whether or not any collections from South America are properly to be referred to this species is an open question.

386. ***Puccinia Baccharidis-spartea*** Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, laxius gregariis, in maculis magnis flavidisque confertis, prominentibus, punctiformibus, flavidis vel aurantiacis, globosis vel depresso globosis, 150–180  $\mu$  altis, 200–220  $\mu$  latis; periphysibus non extrusis.

I. Aecidiis hypophyllis, caematiformibus, paucis, in maculis flavescentibus contra pycnidia dispositis, magnis, 0.5–1.2 mm. diam., tarde nudis, pulverulentis, subflavis, epidermide inflata irregulariterque rumpente diu tectis; aecidiosporis late ellipsoideis vel subglobosis, 24–30  $\times$  30–38  $\mu$ ; tunica hyalina, 2–2.5  $\mu$  cr., finibus quandoque leniter incrassata ad 3–3.5  $\mu$ , crasse et prominenter tuberculata, verrucis inter se longe remotis sed quandoque confluentibus itaque costas elongatas efformantibus praedita.

II. Uredosoris amphigenis, sparsis, parvis, 0.3–0.4 mm. diam., tarde nudis, albidis, pulverulentis, epidermide diu tectis; uredosporis ellipsoideis, 24–26  $\times$  30–35  $\mu$ ; tunica hyalina, 2–2.5  $\mu$  cr., minute crebreque echinulata, poris obscuris praedita.

III. Teleutosoris plerumque hypophyllis, sparsis, rotundatis, 0.2–0.5 mm. diam., mox nudis, castaneo-brunneis, germinando cinereis, primum applanatis, dein pulvinatis; epidermide rupta aegre visibili; teleutosporis ellipsoideis, oblongis vel clavatis, 24–30  $\times$  45–62  $\mu$ , supra rotundatis, infra plerumque rotundatis sed quandoque ad pedicellum contractis, non vel leniter septo con-



strictis; tunicae cinnamomeo- pallide castaneo-brunnea, 1-1.5  $\mu$  cr., apice ad 6-8  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Baccharis sparteae* Benth. San Felipe, Sur Yungas, Bolivia, May 21, 1920, 633.

A species separable from others on this host genus by the strongly tuberculate aeciospore wall with markings sparsely placed, and by the large, broad teliospores, thickened at the apex. The teliospores are somewhat like those of *P. chilensis* Diet. & Neg., but the urediniospores are very different.

387. PUCCINIA CAEOMATIFORMIS Lagerh. in Sydow, Monog. Uredin. 1: 24. 1902.

? *Puccinia colossea* Speg. Rev. Argent. de Bot. 1: 111. 1925.

*Baccharis floribunda* H.B.K. San Felipe, Sur Yungas, Bolivia, May 19, 1920, 613; Coroico, Nor Yungas, Bolivia, June 11, 1920, 728; Riobamba, Ecuador, Aug. 10, 1920, 859; Quito, Ecuador, Aug. 13, 1920, 874; Cuenca, Azuay, Ecuador, Sept. 10, 1920, 972.

*Baccharis subpenninervis* Sch. Bip. Sorata, Bolivia, Apr. 12, 1920, 512; San Felipe, Sur Yungas, Bolivia, May 19, 1920, 615.

*Baccharis* sp. (aff. *B. glutinosa* Pers.) Huigra, Chimborazo, Ecuador, Aug. 3, 1920, 814.

*Baccharis* sp. El Chaco, Sur Yungas, Bolivia, May 25, 1920, 644; Urubamba, Cuzco, Peru, July 3, 1920, 757; Huigra, Chimborazo, Ecuador, Aug. 4, 1920, 843; Foot of Cotopaxi, Ecuador, Aug. 12, 1920, 873; Portovelo, Prov. del Oro, Ecuador, Sept. 22, 1920, 998.

While this species seems to have been reported previously only from Ecuador and Colombia, it would appear to be quite common in the Andes region.

*Puccinia colossea* Speg. is cited as a possible synonym. The type has not been available.

388. PUCCINIA CHILENSIS Dietel & Neger, in Engl. Bot. Jahrb. 22: 354. 1896.

*Baccharis racemosa* (Mol.) DC. Zapallar, Chile, Feb. 1, 1920, 312.

This collection is typical for the species, the characters of which are very distinct. The species is somewhat like *P. Baccharidis* Dietel & Holway, but the teliospores are much broader and the urediniospores have four equatorial pores. The teliospore pedicel may be inflated as in *P. Baccharidis*.

389. *Puccinia consueta* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, prominentibus, crebre gregariis, maculis flavidis profunde insidentibus, globosis vel ellipsoideis, 150–200  $\mu$  latis, 190–210  $\mu$  altis.

I. Aecidiis amphigenis sed utplurimum hypophyllis, cum nervis foliorum saepe immixtis, magnis, 0.5–0.8 mm. diam., caematiformibus, tarde nudis, soro flavescenti praeditis, pulverulentis, epidermide irregulariter erumpente diu tectis; aecidiosporis ellipsoideis, 21–24  $\times$  30–34  $\mu$ ; tunica hyalina vel flavescenti, 1.5–2  $\mu$ , crebre minuteque verrucosa, striata.

II. Uredosoris hypophyllis, sparsis, rotundatis, parvis, 0.2–0.4 mm. diam., flavidis, mox nudis, pulverulentis, epidermide plerumque visibiliter cinctis; uredosporis subglobosis vel late obovatis, 22–25  $\times$  24–27  $\mu$ , tunica flavescenti tenui 1–1.5  $\mu$  minute crebreque verrucosa praeditis; poris parum obscuris sed adpa-renter 3, aequatorialibus.

III. Teleutosoris hypophyllis, sparsis, parvis, rotundatis, 0.3–0.5 mm. diam., mox nudis, obscure cinnamomeo-brunneis, dein germinando cinereis, pulvinatis; epidermide rupta non visibili; teleutosporis ellipsoideis, oblongis vel clavatis, 18–24  $\times$  45–60  $\mu$ , apice rotundatis, infra pedicellum versus rotundatis vel contractis, septo leniter vel non constrictis; tunica aurato-brunnea, 1.5–2  $\mu$  cr., angulis superioribus loculi inferioris valde et apice usque 6–8  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior, non inflato.

*Baccharis* (Near *B. saliens* Rusby), Quito, Ecuador, Aug. 23, 1920, 940.

Separable because of urediniospore characters and the narrow teliospores, greatly thickened at the apex.

390. *Puccinia consulta* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, numerosis, in maculis subflavis laxegregatim dispositis, punctiformibus, primum aurantiaceis, dein brunneolis, profunde insidentibus, ellipsoideis, parvis, 75–90  $\mu$  latis, 90–120  $\mu$  altis; periphysibus fasciculum 30–45  $\mu$  altum efformantibus.

I. *Aecidiis hypophyllis*, plerumque singulatim sed quandoque in greges 2-4 dispositis, magnis, caematiformibus, rotundatis vel irregularibus, 0.5-1.0 mm. diam., peridio carentibus, epidermide inflata irregulariterque erumpente diu tectis; aecidiosporis subglobosis vel saepius late ellipsoideis,  $20-26 \times 30-40 \mu$ , quandoque longioribus et tunc una vel utraque fine subacutis; tunica incolori, tenui, 1-1.5  $\mu$ , minutius sed conspicue verrucoso-rugosa, verrucis saepe confluentibus sed non striatis praedita.

III. *Teleutosoris hypophyllis*, sparsis vel utplurimum gregaris, saepe inter aecidia confertis, parvis, rotundatis, 0.2-0.5 mm. diam., pallide castaneo-brunneis, germinando cinerascentibus, compactis, pulvinatis, epidermide rupta non conspicuis; teleutosporis clavatis, ellipsoideis vel oblongis,  $18-24 \times 45-60 \mu$ , supra rotundatis, infra rotundatis vel saepius contractis, non vel lentissime septo constrictis, tunica pallide cinnamomeo- vel aurato-brunneola 1  $\mu$  cr. apice ad 5-8  $\mu$  crassiore levi praeditis; pedicello hyalino, sporam aequante vel duplo longiore, utplurimum brevior.

*Baccharis orgyalis* DC. Itatiaya, Rio de Janeiro, Brazil, May 19, 1922, 1870; Therezopolis, Rio de Janeiro, Brazil, Sept. 28, 1921, 1161; Varzea, Therezopolis, Rio de Janeiro, Brazil, Sept. 30, 1921, 1176 (type).

*Baccharis pauciflosculosa* DC. Bosque da Saude, São Paulo, Brazil, Feb. 1, 1922, 1525.

*Baccharis Schultzii* Baker, Ouro Preto, Minas Geraes, Brazil, Dec. 9, 1921, 1377; Bosque da Saude, São Paulo, Brazil, Feb. 1, 1922, 1524; Campos do Jordão, São Paulo, Brazil, Apr. 24, 1922, 1768.

*Baccharis* sp. Petropolis, Rio de Janeiro, Brazil, Oct. 29, 1921, 1253, Nov. 1, 1921, 1266; Novo Friburgo, Rio de Janeiro, Brazil, Jan. 2, 1922, 1444; Itatiaya, Rio de Janeiro, Brazil, May 18, 1922, 1859.

These collections were at first referred to *P. Montoyae* Mayor on the basis of description. A comparison with the type material, however, shows that species to be quite different. In *P. Montoyae* the teliospores are usually strongly constricted, and only very slightly thickened at the apex, about 4  $\mu$ . Often the thickening is merely at the sides of the apical germ pore. The aeciospores also are smaller, with the wall markings finely verrucose and arranged in longitudinal rows.

The description is drawn largely from specimen No. 1176 on *Baccharis orgyalis* DC. The other collections, in general, show remarkably close correspondence in teliospore characters and in aecial characters where present. No uredinia or urediniospores could be found in any of the collections. The collection on *B. paucifloculosa* has aeciospores somewhat smaller and with rather finer wall markings, more closely set, with less tendency to be rugose.

391. *PUCCINIA CUZCOENSIS* Arth. Bot. Gaz. 65: 471. 1918.

*Baccharis floribunda* H.B.K. Hacienda del Urco, Urubamba Valley, Cuzco, Peru, July 4, 1920, 764.

*Baccharis Fevillei* DC.? Arequipa, Peru, July 10, 1920, 769.

The type collection of this species was made in the same region as the first specimen listed above, and on the same host. Only aecia and uredinia were known when the species was described. The urediniospores are very characteristic. The original description states that the pores are two and equatorial. There are six pores, two equatorial, two near the apex and two near the base. The two at the equator are on an axis which is at right angles to that between each of the two pairs near the extremities. When the two equatorial pores are in optical section, the spores appear rhomboidal in outline, and the pores at either end are in face view; when the equatorial pores are in face view, the spore is ellipsoid or oblong and the two sets of pores at the ends appear in optical section.

Both collections bear telia. These are scattered, pulvinate, dark brown, becoming cinereous by germination. Teliospores clavate or cylindrical 24-30 by 72-90  $\mu$ , rounded or obtuse above, usually narrowed below, constricted at the septum. The wall is cinnamon brown, firm but thin, 1-1.5  $\mu$ , thickened 5-8  $\mu$  at the apex. The pedicels are long, 1-1.5 times the length of the spore and often inflated. The telia and teliospores somewhat resemble those of *P. caeomatiformis* Lag. In connection with the original description, Arthur comments on the resemblance of the aecia to *P. Montoyae* Mayor, which occurs on the same host in Colombia. The species is, however, very different from *P. Montoyae*, especially in teliospore characters.

392. PUCCINIA EVADENS Hark. Bull. Calif. Acad. 1: 34. 1884.

*Baccharis floribunda* H.B.K.? La Paz, Bolivia, March 20, 1920, 439.

*Baccharis platypoda* DC. Ouro Preto, Minas Geraes, Brazil, Dec. 7, 1921, 1369.

*Baccharis* sp. La Paz, Bolivia, March 20, 1920, 437; Bello Horizonte, Minas Geraes, Brazil, Nov. 23, 1921, 1329; Campos do Jordão, São Paulo, Brazil, Apr. 20, 1922, 1741, Itatiaya, Rio de Janeiro, Brazil, May 18, 1922, 1860.

Collections have been tentatively referred to *P. evadens* Hark., which have large, broad teliospores which are considerably thickened at the apex, and which have broad, usually colorless urediniospores with rather sparse wall markings.

The forms on *Baccharis* having large, broad teliospores, thickened at the apex, are difficult to assign with any degree of satisfaction. It would seem to the writer that there are several species in South America usually referred either to *P. evadens* or *P. Baccharidis*. Just what the specific limits are; is difficult to determine from the usually meagre material available.

393. *Puccinia expetiva* Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis, paucis, maculis decoloratis subhypertrophicis insitis, punctiformibus, subglobosis vel obovatis, 150–180  $\mu$  altis, 165–180  $\mu$  latis; periphysibus non prominentibus.

I. Aecidiis epiphyllis, gregariis, circum gregem pycnidiorum in maculis decoloratis saepe subforte hypertrophicis dispositis, magnis, profunde insidentibus, matricibus inflatis dui velatis sed tandem poro irregulari apertis, soro flavido instructis; aecidiosporis subglobosis vel ellipsoideis, 22–28  $\times$  30–38  $\mu$ ; pariete incolori, crasso, 2.5–3  $\mu$ , utraque fine ad 4–6  $\mu$  quandoque incrassata, sparsissime et valde echinulata, poris obscuris praedita.

III. Teleutosoris hypophyllis, sparsis, plerumque in maculis subflavis dispositis, rotundatis, 0.4–0.8 mm. diam., mox nudis, splendide castaneo-brunneis, ob germinationem cinereis, compactis, primum applanatis, dein pulvinatis, epidermide rupta in soris junioribus solis cinctis; teleutosporis ellipsoideis, oblongis vel subclavatis, 26–32  $\times$  65–90  $\mu$ , supra rotundatis, infra pedicellum versus rotundatis vel contractis, septo leniter vel non contractis; tunica nitide aurato- vel pallide castaneo-brunnea, 1–2  $\mu$  cr., apice usque ad 6–9  $\mu$  incrassata, levi; pedicello hyalino, sporam longitudine aequante, in umbilico lato, quandoque leniter inflato, dein flexuoso.

*Baccharis* sp. Huigra, Chimborazo, Ecuador, Aug. 4, 1920, 831.

Distinguished from other species having aeciospores with echinulate wall markings by the long teliospores greatly thickened at the apex and by the thickness of the aeciospore wall and the strong, sparsely placed wall markings.

The pycnia and aecia in this collection are old, admitting of only incomplete description.

394. *PUCCINIA HENNINGSII* Dietel, *Hedwigia* 36: 31. 1897.

*Caeoma Negerianum* Dietel, in *Engl. Bot. Jahrb.* 22: 357. 1896.

*Baccharis dracunculifolia* DC. Sabará, Minas Geraes, Brazil, Dec. 2, 1921, 1359; Bosque da Saude, São Paulo, Brazil, Jan. 31, 1922, 1523; Poá, São Paulo, Brazil, Apr. 14, 1922, 1732.

*Baccharis* sp. Therezopolis, Rio de Janeiro, Brazil, Sept. 28, 1921, 1153, Sept. 29, 1921, 1171, Oct. 6, 1921, 1195; Petropolis, Rio de Janeiro, Brazil, Oct. 21, 1921, 1241; Novo Friburgo, Rio de Janeiro, Brazil, Jan. 2, 1922, 1440, Jan. 5, 1922, 1457; Bosque da Saude, São Paulo, Brazil, Jan. 31, 1922, 1517.

The type collection of this species was made at Blumenau, Brazil, by E. Ule (No. 910) on the host first listed above. The species seems to be a distinct one. Aecia are present in some of the collections listed above. No urediniospores were found. Collections have been included which have aeciospores finely verrucose with markings arranged in lines sometimes forming striae, but more commonly forming an irregular net work, and with teliospores having colorless walls, not over 60  $\mu$  long and essentially unthickened at the apex. There is some variation, and it may be that there is more than one species in this group.

*Caeoma Negerianum* is included as a synonym on the authority of Dietel (*Ann. Myc.* 12: 87. 1914). Arthur includes this *Caeoma* under *Puccinia evadens*.

395. *Puccinia impolita* Jackson & Holway, sp. nov.

II. *Uredosoris amphigenis*, sparsis, parvis, rotundatis, 0.2–0.4 mm. diam., cinnamomeo-brunneis, tarde nudis, pulverulentis.

epidermide inflata diu tectis; uredosporis late ellipsoideis vel obovatis,  $23-25 \times 27-32 \mu$ ; tunica cinnamomeo- vel aurato-brunnea,  $1.5-2 \mu$  cr., sparsius minuteque echinulata; poris obscuris, 3, fere aequatorialibus.

III. Teleutosoris amphigenis, sparsis, rotundatis, 0.2-0.4 mm. diam., nigricantibus, tarde nudis, dein pulverulentis, epidermide rupta cinctis; teleutosporis late ellipsoideis,  $26-32 \times 38-48 \mu$ , utrinque rotundatis, medio non constrictis; tunica obscure castaneo-brunnea,  $4-5 \mu$  cr., apice et supra porum cellulae inferioris septo ad  $9 \mu$  incrassata, sparse rugoso-reticulata, plicis humilibus interruptisque instructa; pedicello hyalino, sporam aequante vel duplo longiore, firmo,  $6-9 \mu$  diam., saepe infra angustato.

*Baccharis scandens* Pers. Sorata, Bolivia, Apr. 19, 1920, 546.

The only *Baccharis* rust which we have encountered having thick, prominently marked teliospore walls.

396. *Puccinia improcera* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis, in maculis flavescentibus vel decoloratis crebre aggregatis, punctiformibus, globosis vel ellipsoideis,  $95-110 \mu$  altis,  $90-100 \mu$  latis; periphysibus fasciculum densum  $30-45 \mu$  altum efformantibus.

I. Aecidiis hypophyllis, singulatim vel in greges 2-4 contra pycnidia dispositis, minusculis, 0.5-0.8 mm. diam., profunde insidentibus, caematiformibus, tarde nudis, soro albido instructis, pulverulentis, epidermide inflata diu tectis; aecidiosporis ellipsoideis,  $18-24 \times 22-30 \mu$ , tunica  $2-2.5 \mu$  moderate prominenter rugosa praeditis.

II. Uredosoris aliis hypophyllis aliisque cauliculis, sparsis, rotundatis, 0.2-0.4 mm. diam., his majoribus et elongatis, utrisque pallide cinnamomeo-brunneis, mox nudis, pulverulentis, epidermide rupta plerumque visibiliter cinctis; uredosporis ellipsoideis vel obovatis,  $18-20 \times 21-26 \mu$ ; tunica pallide cinnamomeo-brunnea,  $1-1.5 \mu$  cr., sparse ac tenuiter echinulata, area levi circum poros praedita; poris 2, aequatorialibus.

III. Teleutosoris hypophyllis, sparsis, rotundatis, parvis, 0.2-0.4 mm. diam., obscure cinnamomeo- vel pallide castaneo-brunneis, dein e germinatione cinereis, mox nudis, pulvinatis; epidermide rupta non visibili; teleutosporis ellipsoideis, oblongis vel clavatis,  $15-20 \times 30-46 \mu$ , supra rotundatis vel obtusis, infra ad pedicellum rotundatis vel contractis, septo plerumque visibiliter constrictis, tunica tenui  $1-1.5 \mu$  apice ad  $3-4 \mu$  leniter incrassata levi praeditis; pedicello hyalino, sporam aequante vel brevior.

*Baccharis anomala* DC. Campos do Jordão, São Paulo, Brazil, Apr. 20, 1922, 1740 (type); Curitiba, Paraná, Brazil,



June 20, 1922, 1977; Mogy das Cruzes, São Paulo, Brazil,  
July 4, 1922, 2003.

This well marked species may be distinguished by the small, narrow teliospores and the small aeciospores with rugose wall markings. It appears to be most closely related to *P. exornata* Arth., from which it differs in having narrower teliospores and smaller urediniospores.

*Uredo Baccharidis-anomalae* Mayor, described from Colombia on the same host, has been compared, and, until aecia and telia are collected in the same region, it seems best to regard it as a distinct species. The urediniospores, while about the same size as our species, have much thicker walls, with the echinulate markings more closely placed and somewhat more prominent.

397. ***Puccinia incomposita*** Jackson & Holway, sp. nov.

O. Pycnidiis non visis, probaliter carentibus.

III. Teleutosoris hypophyllis, in greges 1.5–2.5 mm. diam. collectis, maculis flavescentibus insidentibus, parvis, rotundatis, 0.2–0.3 mm. diam., inter se longe secernatis, saepe concentricis dispositis, primum pallide castaneo-brunneis, deinde germinando parum cinerascentibus, tardius nudis, compactis, applanatis; epidermide rupta visibili; teleutosporis ellipsoideis vel late clavatis,  $18-24 \times 45-60 \mu$ , supra rotundatis, infra pedicellum versus rotundatis vel angustatis, leniter vel non constrictis; tunica pallide cinnamomeo-brunnea,  $1-1.5 \mu$  cr., angulis superioribus cellulae inferioris, praecipue uno latere, magnopere et apice ad  $9-12 \mu$  incrassata, levi; pedicello hyalino, forti, sporam aequante vel saepius brevior.

*Baccharis* sp. Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 7, 1922, 1814.

This species has all the appearance of a micro-form and seems amply distinct. The spore measurements suggest *P. Baccharidis-cylindricae* P. Henn., but in that species the spores are oblong, somewhat broader, and with very long pedicels.

398. ***Puccinia indagata*** Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis sed plerumque epiphyllis, crebre gregariis, areas flavescentes subhypertrophicas occupantibus, punctiformibus, ellipsoideis vel oblongis,  $105-150 \mu$  latis,  $165-180 \mu$  altis; periphysibus non extrusis, superficie hospitis late fasciculatis.



I. Aecidiis epiphyllis, pycnidia circumdantibus, parvis, profunde insidentibus, matricibus inflatis diu velatis, poro apertis; aecidiosporis ellipsoideis,  $22-27 \times 30-35 \mu$ ; tunica hyalina,  $1.5-2.5 \mu$  cr., prominenter sparsiusque echinulata, poris obscuris praedita.

III. Teleutosoris hypophyllis, paucis, sparsis, pallide castaneo-brunneis, parvis,  $0.2-0.4$  mm. diam., tardius nudis, applanatis, epidermide rupta cinctis; teleutosporis ellipsoideis, oblongis vel subclavatis,  $19-25 \times 42-62 \mu$ , supra rotundatis vel obtusis, infra rotundatis vel quandoque subangustatis, leniter vel non septo constrictis; tunica aurato- vel pallide cinnamomeo-brunnea,  $1-1.5 \mu$  cr., apice ad  $4-6 \mu$  incrassata; pedicello hyalino, sporam aequante vel brevior.

*Bagcharis* sp. Alto da Serra, São Paulo, Brazil, Feb. 5, 1922, 1537 (type); São Paulo, Brazil, Feb. 15, 1922, 1559.

This is another of the several species which we have encountered having echinulate aeciospore wall markings. It is most closely related to *P. albula*, from which it differs in having teliospores with apices considerably thickened and aeciospores with thicker walls.

399. *Puccinia inopina* Jackson & Holway, sp. nov.

O. Pycnidiis amphigenis, plerumque epiphyllis, in greges parvos laxè aggregatis, maculis flavidis insidentibus, punctatis, profunde insitis, magnis, globosis, pyriformibus vel depresso globosis,  $150-210 \mu$  altis,  $180-210 \mu$  latis; periphysibus brevibus.

I. Aecidiis amphigenis sed plerumque epiphyllis, circum pycnidia aggregatis, in maculis flavidis insidentibus, circum hypertrophicis, magnis,  $300-400 \mu$  diam., bullatis; peridio nullo; aecidiosporis late ellipsoideis,  $22-26 \times 30-40 \mu$ , una vel utraque fine saepe subacutis; tunica hyalina,  $2.5-4 \mu$  cr., finibus quandoque crassiuscula, parum tenuiter crebreque verrucoso-rugosa, striis longitudinalibus instructa.

III. Teleutosoris hypophyllis, sparsis, parvis,  $0.2-0.4$  mm. diam., mox nudis, pallide castaneo-brunneis, dein germinando cinereis, primum compactis, demum pulvinatis; epidermide rupta non visibili; teleutosporis ellipsoideis vel subclavatis,  $24-29 \times 60-75 \mu$ , supra rotundatis, infra rotundatis vel subangustatis, septo ut plurimum valde constrictis; pariete pallide cinnamomeo- vel aurato-brunneo, tenui  $1 \mu$ , ad apicem usque  $3-4 \mu$  crassato, levi; pedicello hyalino,  $6-9 \mu$  diam., sporam aequante vel duplo superante.

*Baccharis dracunculifolia* DC. Cochabamba, Bolivia, March 11, 1920, 394.

*Baccharis feindalensis* H.B.K. Quito, Ecuador, Aug. 18, 1920, 917 (type).

While resembling somewhat *P. Ancizari* Mayor, this species seems to be amply distinct. It differs from that species chiefly in aeciospore characters. In *P. Ancizari* the aeciospore wall is thinner and the markings are best described as prominently verrucose-tuberculate. The teliospores are somewhat narrower than in our species, and thickened  $5-8\ \mu$  at the apex, with greater thickening in the upper angles of the lower cell.

The collection on *B. dracunculifolia* bears teliospores only, and is referred here on account of the close correspondence in teliospore characters.

399a. ***Puccinia interjecta*** Jackson, nom. nov.

*Puccinia Ancizari* Arth. N. Am. Fl. 7: 476. 1921 (Not Mayor, 1913).

*Allodus Ancizari* Arth. & Orton, N. Am. Fl. 7: 476. 1921.

In connection with the study of the South American *Baccharis* rusts, the writer has had occasion to study a collection made in Guatemala and reported by Arthur (Am. Jour. Bot. 5: 529. 1918) as *Puccinia Ancizari* Mayor. The collection was made by the late E. W. D. Holway at Cerro Quemado, Quezaltenengo, Guatemala, Jan. 21, 1915 (No. 103).

This collection was compared with the type of *P. Ancizari* Mayor, and found to be distinct. In *P. Ancizari* the aeciospore wall is prominently and closely verrucose-tuberculate, while in the Guatemala collection the aeciospore wall is finely echinulate. The name, *Puccinia interjecta*, is proposed for the rust on the collection mentioned above. A description drawn exclusively from the Guatemalan material will be found in the North American Flora (l.c.).

This species is one of a group occurring on *Baccharis* which have epiphyllous aecia and aeciospores with echinulate wall markings. The teliospore characters correspond most closely to those of *P. expetiva*, but the aeciospores are quite different, having wall markings finely echinulate and moderately spaced. In the latter the aeciospore wall markings are strong and sparsely spaced.

400. *Puccinia perincerta* Jackson & Holway, sp. nov.

O. Pycnidiis non visis (probaliter praesentibus).

I. Aecidiis cauliculis, in ramis minoribus bullulas fusiformes vel irregulares saepe 2-4 cm. longas efficientibus, rotundatis vel oblongis, magnis, bullatis, mox dehiscentibus, peridio carentibus, pulverulentis, e matricibus ruptis emergentibus; aecidiosporis subglobois vel late ellipsoideis,  $24-30 \times 30-45 \mu$ , una fine quandoque acutis; tunica hyalina,  $1-1.5 \mu$ , minutissime crebreque verrucosa, non vel raro striata.

III. Teleutosoris amphigenis sed plerumque hypophyllis, sparsis vel gregariis, rotundatis, 0.4-1.0 mm. diam., mox nudis, castaneo-brunneis, dein e germinatione cinereis, compactis, pulvinatis; epidermide rupta non conspicua; teleutosporis cylindraceis vel subclavatis,  $24-30 \times 60-80 \mu$ , supra rotundatis, infra rotundatis vel subangustatis, septo plerumque valde constrictis; tunica pallide cinnamomeo- vel aurato-brunnea,  $2-3 \mu$  cr., apice usque ad  $6-9 \mu$  incrassata, tereti; pedicello hyalino, forti; parietibus apice  $3 \mu$  cr., quandoque subinflatis.

*Baccharis tridentata* Vahl. Viña del Mar, Chile, Sept. 6, 1919, 11 (type).

*Baccharis* (Near *B. alaternoides* H.B.K.) Termas de Chillán, Chile, Jan. 4, 1920, 273.

*Puccinia perincerta* forms one of a series of species having teliospores with evident thickening at the apex, the length of which averages over  $60 \mu$ . All appear to be without uredinia. The several species are most easily separated by aeciospore characters. The teliospores of this species differ from *P. inopina* and *P. Ancizari* in that the side walls of the teliospores are  $2-3 \mu$  thick. In *P. Ancizari* the aeciospore wall is strongly verrucose-tuberculate, while in our species the markings are finely and closely verrucose, and not conspicuously arranged in lines as in *P. inopina*.

401. *Puccinia perspicabilis* Jackson & Holway, sp. nov.

O. Pycnidiis non visis, verisimiliter carentibus.

III. Teleutosoris hypophyllis, crebre gregariis et saepe in greges 1-3 mm. diam. plus minusve confluentibus, maculis decoloratis insidentibus, parvis, rotundatis, 0.2-0.4 mm. diam., mox nudis, pallide castaneo-brunneis, subpulverulentis; epidermide rupta inconspicua; teleutosporis ellipsoideis, oblongis vel clavatis,  $18-23 \times 38-60 \mu$ , supra rotundatis, infra pedicellum versus ro-

tundatis vel contractis, septo non vel leniter constrictis; tunica tenui, 1–1.5  $\mu$ , aurato-brunnea, apice leniter ad 2.5–4  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Baccharis* sp. Guayaquil, Ecuador, July 31, 1920, 797.

The teliospores of this species are like those of *Puccinia exornata* Arth., but the grouping of the telial sori is very different. The aspect is that of a micro-form, and is, perhaps, to be interpreted as a correlated species.

402. ***Puccinia pervenusta*** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis vel gregariis, irregulariter rotundatis, 0.2–0.5 mm. diam., profunde insidentibus, tarde nudis, soro flavescenti instructis, pulverulentis, epidermide fissa cinctis; uredosporis pyriformibus vel obovoideis, 22–27  $\times$  32–48  $\mu$ , supra rotundatis sed infra ad pedicellum plerumque angustatis; tunica hyalina, 2–3  $\mu$  cr., supra ad 3.5  $\mu$  leniter incrassata, minute verrucoso-rugosa, in lineis interruptis longitudinalibusque 2.5–4  $\mu$  inter se remotis striata, poris obscuris praedita.

III. Teleutosoris non visis; teleutosporis uredosoris immixtis, ellipsoideis vel oblongis, 26–30  $\times$  58–70  $\mu$ , supra rotundatis, infra rotundatis angustatis, septo fortiter constrictis; tunica aurato-brunnea, 2–3  $\mu$  cr., apice leniter incrassata ad 3.5–4  $\mu$ , levi; pedicello hyalino, sporam aequante vel longiore.

*Baccharis* sp. Hacienda La Florida, Sur Yungas, Bolivia, May 27, 1920, 663.

Among the numerous rusts on *Baccharis* this species is easily distinguished by the longitudinally striate markings on the walls of the urediniospores. The uredinia appear remarkably like the caeomoid aecia of some other species, but the spores are borne on pedicels. No aecia or pycnia could be found in our material. Only a few teliospores were found in the uredinia and the description may prove inadequate.

403. ***Puccinia praeculta*** Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis vel costis suffultis, in greges parvos crebre aggregatis, maculis primum flavidis dein decoloratis insidentibus, prominentibus, punctiformibus, globosis vel depresso globosis vel conicis, 100–150  $\mu$  altis, 135–150  $\mu$  latis; periphysibus fasciculum laxum 40–60  $\mu$  altum efformantibus.

I. Aecidiis ut plurimum hypophyllis sed saepe costis suffulgentibus amphigenis, singulatim vel in greges 2 ampliusve dispositis,

magnis, caeomatiformibus, 0.8–1 mm. diam., plerumque non profunde insidentibus, soro albedo instructis, pulverulentis, tarde nudis, epidermide inflata diu tectis, irregulariter apertis; aecidiosporis anguste ellipsoideis vel obovatis,  $18-24 \times 30-42 \mu$ , quandoque longioribus; tunica hyalina,  $2-2.5 \mu$  cr., apice adparenter ad  $3-6 \mu$  incrassata, crassissime rugosa, plicis prominulis inter se  $3-5 \mu$  remotis instructa.

III. Teleutosoris hypophyllis, sparsis vel gregariis, rotundatis, 0.3–0.8 mm. diam., nitide castaneo-brunneis, deinde ob germinationem cinereis, mox nudis, applanatis, dein pulvinatis; epidermide rupta non visibili; teleutosporis ellipsoideis vel clavatis, saepe irregularibus,  $21-27 \times 40-50 \mu$ , supra rotundatis, infra pedicellum versus rotundatis vel angustatis, non vel vix constrictis, tunica pallide castaneo-brunnea  $1.5-2.5 \mu$  cr. apice ad  $5-9 \mu$  incrassata levi praeditis; pedicello hyalino, sporam aequante vel brevior, quandoque lateraliter inserto.

*Baccharis* sp. San Felipe, Sur Yungas, Bolivia, May 21, 1920, 635.

A very distinct species, separable from all others which we have examined by the very prominent, sparsely placed, longitudinal ridges on the aeciospore wall. These ridges sometimes extend the length of the spore without interruption, or may be made up of interrupted, elongated markings. They may be strictly longitudinal or oblique, giving a somewhat spiral effect.

404. *Puccinia praedicabilis* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, punctiformibus, paucis in omni grege dispositis, maculis flavescentibus insitis, magnis, globosis,  $150-170 \mu$  diam.; periphysibus breviter fasciculatis.

I. Aecidiis hypophyllis, caeomatiformibus, mox nudis, magnis, 0.5–1 mm. diam., pulverulentis, soro flavescenti instructis, epidermide rupta cinctis; aecidiosporis ellipsoideis,  $19-25 \times 30-36 \mu$ ; tunica hyalina,  $2-2.5 \mu$  cr., minute crebreque verrucosa, verrucis non in lineis dispositis praedita.

III. Teleutosoris hypophyllis, sparsis, rotundatis, 0.2–0.4 mm. diam., nitide aurato-brunneis, dein germinationis causa cinereis, compactis, pulvinatis; epidermide rupta non visibili; teleutosporis oblongis vel subclavatis,  $22-27 \times 65-90 \mu$ , supra rotundatis vel obtusis, infra pedicellum versus paulatim contractis, plerumque medio visibiliter constrictis; tunica tenui,  $1.5-2 \mu$ , lateribus pori apicalis ad  $3.5 \mu$  lentissime incrassata, levi; pedicello hyalino, sporam aequante sed utplurimum brevior.

*Baccharis cassinefolia* DC.? Hacienda La Florida, Prov. Sur Yungas, Bolivia, May 26, 1920, 661.

This species is one of a group including *P. Henningsii* and *P. Mayerhansii*, having teliospores with essentially colorless walls, not appreciably thickened at the apex. This species differs from the former in spore size and from the latter in having the aeciospores finely verrucose rather than coarsely so. It also lacks uredinia, which are present in *P. Mayerhansii*.

405. ***Puccinia praedicta*** Jackson & Holway, nom. nov.

*Uredo Baccharidis* Speg. Anal. Soc. Cient. Argent. 17: 121. 1884 (Not *P. Baccharidis* Dietel & Holway).

*Uredo baccharidicola* Speg. Rev. Argent. Bot. 1: 133. 1925 (Not *P. baccharidicola* P. Henn.).

*Baccharis serrulata* DC. Taipas, São Paulo, Brazil, Feb. 7, 1922, 1543; Guarulhos, São Paulo, Brazil, Jan. 30, 1922, 1515; Tremembé, São Paulo, Brazil, Jan. 24, 1922, 1498.

*Baccharis* sp. (Near *B. serrulata*) Campos do Jordão, São Paulo, Brazil, Apr. 28, 1922, 1780; Petropolis, Rio de Janeiro, Brazil, Oct. 18, 1921, 1230.

*Uredo Baccharidis* Speg. (1884) was based on two collections made by Balansa (3434 and 3437), in Paraguay, on *Baccharis* sp. This name was found untenable, as there was already a *Uredo Baccharidis* Lév. (1846), and Spegazzini, in 1925, renamed the species *Uredo baccharidicola*. At that time he records the above collections and others (one of which was collected in São Paulo, Brazil (Usteri 10)) as on *Baccharis serrulata*. Our collections, part of which are on *B. serrulata*, bear urediniospores which agree well with Spegazzini's description. Most of the collections also bear teliospores. Aecia do not occur so far as could be determined. The arrangement of the uredinia suggests a brachy form, but pycnia could not be found. A diagnosis of uredinia and telia drawn from the collections listed above follows:

II. Uredinia amphigenous, scattered or more commonly gregarious on yellowish spots and then chiefly epiphyllous, often arranged concentrically, round, 0.2–0.8 mm. across, yellowish, tardily naked, pulverulent, ruptured epidermis conspicuous; ure-

diniospores obovoid, 22–24 by 26–33  $\mu$ ; wall colorless or slightly tinted, 2–2.5  $\mu$ , finely and rather sparsely echinulate; pores obscure.

III. Telia hypophyllous, scattered, small, round, 0.2–0.6 mm. across, light chestnut brown, becoming cinerous through germination, early naked, applanate becoming pulvinate, ruptured epidermis usually not noticeable; teliospores ellipsoid, oblong or subclavate, 20–22 by 33–44  $\mu$ , rounded above, rounded or occasionally narrowed to pedicel below, not or slightly constricted at septum; wall thin 1–1.5  $\mu$ , cinnamon brown, thickened at the angles in the upper cell and 5–7  $\mu$  at apex, smooth; pedicel colorless, equalling the spore or shorter.

The species suggests *P. montserrates* Mayor, but differs in several characters. The teliospores of that species have thicker, darker colored walls and the urediniospores are considerably larger and the echinulate markings more closely placed.

406. *Puccinia ruderaria* Jackson & Holway, sp. nov.

O, I. Pycnidiis et aecidiis praesentibus (*vide infra*).

II. Uredosoris amphigenis, sparsis, flavidis, rotundatis, 0.2–0.8 mm. diam., tarde nudis, pulverulentis, epidermide rupta conspicue cinctis; uredosporis obovatis, 16–20  $\times$  26–34  $\mu$ ; tunica 1.5–2.5  $\mu$  cr., hyalina vel pallide aurato-brunnea, minute echinulata, verrucis moderate inter se remotis praedita; poris obscuris.

III. Teleutosoris hypophyllis, sparsis, rotundatis, 0.2–0.4 mm. diam., pallide castaneo-brunneis, germinando cinerascentibus, tardius nudis, compactis, primum applanatis, dein subpulvinatis, epidermide rupta primo conspicue cinctis; teleutosporis ellipsoideis vel subclavatis, 20–26  $\times$  42–60  $\mu$ , supra rotundatis sed infra plerumque contractis, septo non vel leniter constrictis; tunica aurato- vel pallide castaneo-brunnea, apice plerumque pallidiore, 1–1.5  $\mu$ , apice ad 6–9  $\mu$  late incrassata, levi; pedicello hyalino, sporam aequante vel dimidio superante.

*Baccharis oxyodonta* DC. Pico Tijuca, Rio de Janeiro, Brazil, Dec. 25, 1921, 1425.

*Baccharis* (Near *B. oxyodonta* DC.) Rio de Janeiro, Brazil, Aug. 23, 1921, 1063, Nov. 11, 1921, 1291 (type); Ouro Preto, Minas Geraes, Brazil, Dec. 9, 1921, 1376; Barbacena, Minas Geraes, Brazil, Dec. 12, 1921, 1382, Dec. 14, 1921, 1397, 1398.



These collections were at first referred to *P. evadens*. The teliospores are, however, much narrower. A few old aecia were found, too old for adequate description, which, however, served to make clear that the species was quite different from *P. evadens*. The aeciospores are 20–24 by 28–35  $\mu$ , with colorless walls, prominently tuberculate-rugose.

The species is somewhat like *P. salebrata*. The aeciospores of that species are, however, much more coarsely tuberculate.

407. *Puccinia salebrata* Jackson & Holway, sp. nov.

O. Pycnidii epiphyllis, numerosis, in maculis decoloratis laxae aggregatis, globosis vel ellipsoideis, 90–120  $\mu$  altis, 100–120  $\mu$  latis; periphysibus breviter laxaeque fasciculatis.

I. Aecidiis hypophyllis, crebre aggregatis, parvis, bullatis, poro apertis; aecidiosporis ellipsoideis, 22–28  $\times$  32–36  $\mu$ ; tunica hyalina, adparenter tenui, crassissime tuberculato-rugosa, verrucis 3–5  $\mu$  altis et una fine adparenter altioribus praedita.

II. Uredosoris hypophyllis, sparsis, parvis, rotundatis, 0.3–50 mm. diam., albidis vel flavidis, tarde nudis, pulverulentis, epidermide rupta cinctis; uredosporis ellipsoideis, 23–26  $\times$  30–34  $\mu$ ; tunica hyalina vel leniter tinctoria, 1.5–2  $\mu$ , tenuiter crebreque echinulata, poris obscuris instructa.

III. Teleutosoris hypophyllis, sparsis, rotundatis, 0.3–0.8 mm. diam., mox nudis, applanatis, dein pulvinatis, splendide castaneo-brunneis, germinationis causa cinerascens; epidermide rupta non visibili; teleutosporis ellipsoideis, oblongis vel subclavatis, 22–28  $\times$  45–60  $\mu$ , supra rotundatis, infra pedicellum versus rotundatis vel attenuatis, septo non vel leniter constrictis; tunica obscure cinnamomeo-brunnea, 1–2  $\mu$  cr., apice ad 6–9  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Baccharis* sp. San Felipe, Prov. Sur Yungas, Bolivia, May 19, 1920, 624.

The characters indicate close relationship with *P. Baccharidis-triplinervis* P. Henn., as represented by Ule 1449, and another unnumbered collection made at the type locality, dated 1883 (See species No. 380, page 128). In our collection the urediniospores and teliospores average considerably larger and the aeciospores are much more prominently tuberculate. The urediniospore wall is thinner and the echinulate markings somewhat more closely placed.

Material of aecia in *P. salebrata* is scanty and old, admitting



only an incomplete description. The aeciospores are, however, quite remarkable. The markings are exceedingly coarse, often elongated and rather closely placed. They appear to be 3-4  $\mu$  high at the sides of the spore, and longer at one end, giving the appearance of a wall thickened at the apex. The thickness of the wall itself could not be determined with certainty.

408. *PUCCINIA UNICOLOR* Arth. Bot. Gaz. 65: 472. 1918.

*Baccharis pulchella* Sch. Bip. La Paz, Bolivia, March 19, 1920, 428, March 24, 1920, 452; Cuzco, Peru, June 30, 1920, 742.

*Baccharis* sp. Cochabamba, Bolivia, March 10, 1920, 385; La Paz, Bolivia, March 26, 1920, 469.

Aecia are present in collections 428, 472 and 385. These are accompanied by yellowish, epiphyllous pycnia. The aecia are hypophyllous, large and caeomoid. The aeciospores are ellipsoid, often somewhat pointed at one or both ends, 21-24 by 30-42  $\mu$ . The wall is colorless and finely verrucose, with markings arranged in lines.

This species, originally described from material collected at Cuzco, Peru, on *Baccharis hemiprionodes* Buek., is so close to *P. sphenica* Arth. from Mexico, that I have been unable to detect any difference in uredinia and telia. It seems best, however, to list it separately until aecia of *P. sphenica* are known. One of the collections, 742, was collected near the type locality.

*P. preandina* Speg. has been recorded on *B. pulchella* from Argentina. This species, however, differs in several features.

409. *Uredo illaudanda* Jackson & Holway, sp. nov.

II. *Uredosoris amphigenis*, sparsis vel gregariis, magnis, rotundatis vel ellipticis, 0.4-1.2 mm. diam., tarde nudis, subpulverulentis, castaneo-brunneis, epidermide rupta cinctis; uredosporis oblongis vel anguste obovatis, 18-22  $\times$  22-42  $\mu$ ; tunica castaneo-brunnea, 2-2.5  $\mu$  cr., minute crebreque echinulata, ad apicem verrucis prominentioribus praedita, basi levi vel fere levi; poris 8, duos annulos paulo infra et supra aequatorem situs occupantibus, in utroque annulo poris 4 dispositis.

*Baccharis* sp. Pichilemu, Chile, Oct. 12, 1919, 109.

A well marked species distinguished by the presence of eight wall pores in two bands, and by the closely set, finely echinulate

wall markings, more prominent at apex and disappearing at the base of the spore.

410. **Uredo temucensis** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, magnis, rotundatis vel oblongis, saepe irregularibus, 0.5–1.5 mm. diam., tarde nudis, ex obscure cinnamomeo-castaneo-brunneis, pulverulentis, epidermide inflata et irregulariter rumpente diu tectis; uredosporis ellipsoideis vel obovatis,  $20-22 \times 30-38 \mu$ ; tunica aurato-brunnea, 1.5–2  $\mu$  cr., minutissime et obscure echinulata, verrucis inter se moderate remotis praedita, circa poros levi; poris 3, prominentibus, subaequatorialibus.

*Baccharis* sp. Temuco, Chile, Dec. 5, 1919, 201.

SPECIES ON CARDUACEAE

(Tribe Inuleae)

411. **Puccinia Achyroclines** (P. Henn.) Jackson & Holway, comb. nov.

*Uredo Achyroclines* P. Henn. Hedwigia Beibl. **38**: 70. 1899.

*Achyrocline satureioides Vargasiana* (DC.) Baker, Petropolis, Rio de Janeiro, Brazil, Oct. 29, 1921, 1254; Tremembé, São Paulo, Brazil, March 6, 1922, 1614.

*Achyrocline Vautheriana* DC. Tijuca, Rio de Janeiro, Brazil, Aug. 19, 1921, 1057.

*Achyrocline* sp. Guarulhos, São Paulo, Brazil, Jan. 30, 1922, 1513; La Falda, Argentina, Aug. 14, 1922, 2022.

The uredinia and urediniospores of this species agree well with the description of *Uredo Achyroclines* P. Henn., which was recorded as occurring on *Achyrocline satureioides* from St. Catharina, Brazil.

Teliospores are present in collection 1614. These occur in hypophyllous sori, light chestnut brown in color, obscured by the tomentum of the host. The teliospores are clavate 18–21 by 38–50  $\mu$ , rounded above, narrowed and truncate below. The wall is thin, 1–1.5  $\mu$ , light golden brown, nearly colorless below, broadly and gradually thickened at the apex 6–9  $\mu$ . The pedicel is colorless, broad at point of attachment, equalling the spore or shorter.

412. PUCCINIA GNAPHALIATA (Schw.) Arth. & Bisby, Proc. Am. Phil. Soc. 57: 221. 1918.

*Caecoma (Aecidium) gnaphaliatum* Schw. Trans. Am. Phil. Soc. II, 4: 292. 1832.

*Puccinia investita* Schw. Trans. Am. Phil. Soc. II, 4: 296. 1832.

*Achyrocline glandulosa* Blake, Cuenca, Ecuador, Sept. 12, 1920, 982.

*Achyrocline hyperchlora* Blake, Cochabamba, Bolivia, March 14, 1920, 406.

*Achyrocline polycephala* Rusby, Hacienda La Florida, Sur Yungas, Bolivia, May 30, 1920, 681.

*Achyrocline ramossissima* Britton, La Paz, Bolivia, March 26, 1920, 468.

*Gnaphalium paniculatum* DC.? Cuzco, Peru, July 2, 1920, 754.

*Gnaphalium* sp. La Falda, Argentina, Aug. 14, 1922, 2024.

This species seems not to have been reported previously from South America, but the rust on the specimens listed seems to agree sufficiently well to be so included. The species is known in the North Eastern United States, and in Arizona, California, Mexico and Guatemala. The collections listed above extend the range down the west coast of South America to Argentina.

413. PUCCINIA GNAPHALII (Speg.) P. Henn. Hedwigia Beibl. 41: 66. 1902.

*Uredo Gnaphalii* Speg. Anal. Soc. Ci. Argent. 12: 73. 1881.

*Puccinia gnaphaliicola* P. Henn. Hedwigia Beibl. 38: 68. 1899.

*Puccinia Gnaphalii* Speg. Anal. Mus. Nac. Buenos Aires 19: 309. 1909.

*Gnaphalium purpureum* L. Alto da Serra, São Paulo, Brazil, Jan. 28, 1922, 1503.

*Gnaphalium spicatum* Lam. San Felipe, Sur Yungas, Bolivia, May 22, 1921, 638; Quito, Ecuador, Aug. 15, 1920, 900.

*Gnaphalium spathulatum* Lam. Papudo, Chile, Sept. 20, 1919, 55.

Originally described from Argentina, this species has previously

been reported from Chile and Brazil. It is also known from Guatemala, and the South Eastern United States.

414. PUCCINIA PLUCHEAE (Sydow) Arth. Bull. Torrey Club **49**: 194. 1922.

*Uredo Plucheae* Sydow, Ann. Myc. **1**: 333. 1903.

*Uredo biocellata* Arth. Bull. Torrey Club **33**: 517. 1906.

*Puccinia biocellata* Vesterg. Micr. Rar. Sel. **1267**. 1908.

*Uredo Plucheae* Speg. Anal. Mus. Nac. Buenos Aires **19**: 319. 1909.

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*Pluchea odorata* (L.) Cass. Cochabamba, Bolivia, March 4, 1920, 365; Sorata, Bolivia, Apr. 25, 1920, 571.

*Pluchea Quitoc* DC. Rio de Janeiro, Brazil, Aug. 23, 1921, 1062, Nov. 11, 1921, 1292.

This widely distributed species was originally described from Florida. It is known throughout the West Indies and in Guatemala. In South America it is otherwise known only from Argentina. The specimens from Bolivia bear uredinia and telia.

415. PUCCINIA TESSARIAE (Speg.) Dietel, Ann. Myc. **5**: 246. 1907.

*Uredo Tessariae* Speg. Anal. Soc. Ci. Argent. **12**: 75. 1881.

*Uredo scopigena* P. Henn. Hedwigia **43**: 160. 1904.

*Puccinia Tessariae* Speg. Anal. Mus. Nac. Buenos Aires **19**: 305. 1909.

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*Tessaria absinthioides* DC. Baños de Cauquenes, Chile, Jan. 14, 1920, 296.

416. UROMYCES MEGALOSPERMUS Speg. Anal. Mus. Nac. Buenos Aires **6**: 218. 1899.

*Tessaria integrifolia* R. & P. Choisica, above Lima, Peru, July 22, 1920, 778.

Originally described from Argentina, this species is also known from Colombia.

## SPECIES ON CARDUACEAE

## (Tribe Heliantheae)

- 417.
- AECIDIUM ENCELIAE*
- Arth. Bot. Gaz.
- 65**
- : 472. 1918.

*Encelia canescens* Lam. Arequipa, Peru, July 10, 1920, 768.

This is the second collection of this striking systemic *Aecidium* of which we have any knowledge. It was made at the same locality and on the same host as the type collection.

- 418.
- PUCCINIA ABRUPTA*
- Dietel & Holway; Dietel, Hedwigia
- 37**
- : 208. 1898.

*Puccinia subglobosa* Dietel & Holway; Holway, Bot. Gaz. **31**: 332. 1901.

*Verbesina semidecurrens* Kuntze, Sorata, Bolivia, Apr. 13, 1920, 515.

*Verbesina* sp. Urubamba, Urubamba Valley, Cuzco, Peru, July 3, 1920, 758A.

*Viguiera aurea* (H.B.K.) Hieron. Huigra, Chimborazo, Ecuador, Aug. 3, 1920, 827.

*Viguiera australis* Blake, Cochabamba, Bolivia, March 12, 1920, 402.

*Viguiera lanceolata* Britton, Hacienda La Florida, Sur Yungas, Bolivia, May 27, 1920, 664.

*Viguiera pazensis* Rusby, Cochabamba, Bolivia, Feb. 25, 1920, 316, March 1, 1920, 354; La Paz, Bolivia, March 26, 1920, 466, March 31, 1920, 486; Sorata, Bolivia, Apr. 11, 1920, 499, Apr. 21, 1920, 559; Villa Aspiazu, Sur Yungas, Bolivia, May 31, 1920, 685.

*Viguiera Pflanzii* Perk. La Paz, Bolivia, March 23, 1920, 444, May 12, 1920, 599; Sorata, Bolivia, Apr. 14, 1920, 522; Cuzco, Peru, July 2, 1920, 753; Arequipa, Peru, July 11, 1920, 773.

*Viguiera quitensis* (Benth.) Blake, Quito, Ecuador, Aug. 13, 1920, 881, Aug. 21, 1920, 933.

*Viguiera retroflexa* Blake, Hacienda Anacuri, Nor Yungas, Bolivia, June 4, 1920, 716.

The above collections are referred to this species with some hesitation. Those on *Viguiera* are quite certainly all one spe-

cies, though showing some variation. All have two subequatorial pores in the urediniospore wall. The type of the species is based on material from Mexico on *Viguiera helianthoides* H.B.K. Our collections have urediniospores with somewhat thinner walls and more closely echinulate. Material on some other species of *Viguiera* from Mexico fits our material very well.

It is still an open question whether any *Verbesina* rusts are properly referred to this species. The same treatment is followed here as was done in the preparation of the species on these host genera for the North American Flóra. The group is a difficult one and needs re-study with all the type material available.

419. *PUCCINIA ACANTHOSPERMI* P. Henn. Hedwigia 41: 296. 1902.

*Acanthospermum australe* (L.) Kuntze, Novo Friburgo, Rio de Janeiro, Brazil, Jan. 1, 1922, 1438; São Bernardo, São Paulo, Brazil, Jan. 20, 1922, 1486.

Described originally on *A. xanthioides*, this species has been reported only twice before, and both collections have been from the same region in which those listed above were taken.

420. *Puccinia boliviana* Jackson & Holway, sp. nov.

O. Pycnidiiis epiphyllis, crebre gregariis, in greges 3-5 confertis, maculis flavidis et subhypertrophicis insidentibus, paucis, prominentibus, punctatis, globosis vel ellipsoideis, 135-150  $\mu$  latis, 150-180  $\mu$  altis; periphysibus non prominentibus.

I. Aecidiis epiphyllis vel in nervis amphigenis, circum gregem pycnidiorum gregariis, soro flavescenti praeditis; peridio albo, prominenti, membranaceo, cylindraceo, 2 mm. alto, tandem lacerato; loculis peridialibus e facie visis polygonis, 22-28  $\times$  45-60  $\mu$ , tunica hyalina crebre minuteque verrucosa instructis; aecidiosporis parum angulato-ellipsoideis vel globosis, 20-24  $\times$  25-32  $\mu$ ; pariete aurato-flavo, 1.5-2.5  $\mu$ , una fine quandoque crassiore, 3-3.5  $\mu$ , crebrius minuteque, saepe una fine valde, verrucosotuberculato.

II. Uredosoris hypophyllis, sparsis, cinnamomeo-brunneis, parvis, rotundatis, 0.2-0.4 mm. diam., mox nudis, pulverulentis, epidermide rupta inconspicuis; uredosporis late depresso sphaeroideis sed adparenter e latere ellipsoideis 20-22  $\times$  24-26  $\mu$  et longitudinaliter visis globosis; tunica pallide cinnamomeo-brunnea, 1-1.5  $\mu$  cr., minute crebriusque echinulata; poris 2, utraque fine axis longi aequatorialibus.

III. *Teleutosoris hypophyllis*, sparsis, castaneo-brunneis, germinando cinerascens, parvis, rotundatis, 0.2–0.5 mm. diam., mox nudis, compactis, pulvinatis; epidermide fissa non visibili; teleutosporis lineari-oblongis vel elongato-clavatis, 15–21  $\times$  60–100  $\mu$ , supra rotundatis vel obtusis, infra rotundatis vel saepius contractis, septo plerumque visibiliter constrictis; tunica pallide aurato-brunnea, infra pallidior, 1–1.5  $\mu$  cr., apice ad 6–12  $\mu$  incrassata, levi; pedicello incolori, sporam aequante vel saepius brevior.

*Oyedaea boliviana* Britton, Hacienda La Florida, Sur Yungas, Bolivia, May 29, 1920, 676 (type); Villa Aspiazu, Sur Yungas, Bolivia, May 31, 1920, 691, June 1, 1920, 696; Hacienda Anacuri, Nor Yungas, Bolivia, June 3, 1920, 701.

*Oyedaea* sp. Coroico, Nor Yungas, Bolivia, June 12, 1920, 732.

This is one of a series of three species having very similar teliospores, but which are strikingly different in urediniospore characters. The first one to be described is *Puccinia Oyedaeae* Mayor, on *Oyedaea* sp. from Colombia. Only the teliospores were observed by Mayor, who interpreted the species as a leptotheca. Urediniospores were, however, found in the type material. The second species was collected in Costa Rica by E. W. D. Holway, and assigned by Arthur in error to *P. Oyedaeae* Mayor. (See discussion under species No. 423a, page 163.) The three species may be distinguished as follows:

- |  |                             |
|--|-----------------------------|
| Urediniospores with two equatorial pores.....  | 420. <i>P. boliviana</i> .  |
| Urediniospores with several pores.   |                             |
| Urediniospores oblate sphaeroid 18–21 $\mu$ diam., walls echinulate, thin.....               | <i>P. Oyedaeae</i> .        |
| Urediniospores globoid or ellipsoid 23–27 $\times$ 26–32 $\mu$ , walls verrucose, thick..... | 423a. <i>P. Holwayula</i> . |

421. PUCCINIA CALEAE Arth. Bot. Gaz. 40: 201. 1905.

*Calea cuneifolia* DC. São Bernardo, São Paulo, Brazil, Jan. 20, 1922, 1485; Ypiranga, São Paulo, Brazil, Feb. 23, 1922, 1591; Arthur Anvim, São Paulo, Brazil, March 15, 1922, 1631.

*Calea huigrensis* Blake, Huigra, Chimborazo, Ecuador, Aug. 7, 1920, 856.

*Calea* sp. São Bernardo, São Paulo, Brazil, Jan. 20, 1922, 1484.

This species is abundant in Central America, but does not appear to have been recorded from South America. It seems best to assign these collections as above, since we can detect no essential difference between them and others from Central America.

422. *Puccinia capitulata* Jackson & Holway, sp. nov.

O. I. Pycnidiis et aecidiis incognitis.

II. Uredosoris hypophyllis, sparsis vel gregariis, rotundatis, parvis, 0.2–0.5 mm. diam., aurato- vel cinnamomeo-brunneis, mox nudis, pulverulentissimis; epidermide rupta ut plurimum non visibili; uredosporis globosis, 23–26  $\mu$  diam.; tunica aurato-brunnea, tenui, 1–1.5  $\mu$ , crebre subtiliterque echinulata; poris obscuris sed apparenter 4–6, sparsis.

III. Teleutosoris hypophyllis, sparsis vel gregariis, rotundatis, 0.3–0.6 mm. diam., nitide castaneo-brunneis, e germinatione cinerascens, compactis, applanatis, demum pulverulentis; epidermide scissa non visibili; teleutosporis oblongis, 22–28  $\times$  50–80  $\mu$ , supra rotundatis vel obtusis, infra rotundatis vel quandoque subangustatis, medio valde constrictis; tunica aurato- ad pallide castaneo-brunnea, 1–1.5  $\mu$  cr., lateribus septo approximatis cellulae inferioris et apice cellulae superioris ad 6–9  $\mu$  late pallideque umbonata, levi; pedicello hyalino, sporam aequante vel plerumque brevior.

*Monopholis hexantha* Blake, Cuenca, Ecuador, Sept. 10, 1920, 973 (type).

*Monopholis Holwayae* Blake, Cuenca, Ecuador, Sept. 15, 1920, 989.

423. *Puccinia examinata* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis, gregariis, maculis decoloratis parumque hypertrophicis insidentibus, punctiformibus, subepidermicis, globosis vel depresso globosis, 135–150  $\mu$  latis, 105–120  $\mu$  altis; periphysibus late humiliterque fasciculatis.

III. Teleutosoris amphigenis, in greges 1.5–3.0 mm. diam. aggregatis, maculis leniter hypertrophicis insidentibus, saepe nerviculis, irregulariter rotundatis, 0.2–0.4 mm. diam., mox nudis, theobrominis, pulverulentis, epidermide fissa cinctis; teleutosporis ellipsoideis vel subclavatis, 20–24  $\times$  34–45  $\mu$ , supra rotundatis, infra rotundatis vel attenuatis, septo valde constrictis; tunica



castaneo-brunnea, 2-2.5  $\mu$  cr., lateribus pori apicalis ad 3  $\mu$  leniter incrassata, sicca minute rugosa sed uda adparenter levi; poro cellulae superioris apicali, poro cellulae inferioris basali, hilo approxinato; pedicello deciduo.

*Verbesina Hallii* Hieron. Quito, Ecuador, Aug. 19, 1920, 922.

This micro-cyclic species differs from *P. ferox* Dietel & Holway and *P. cundinamarcensis* Mayor in the thicker walls and in the position of the pore in the lower cell. In our species the pore of the lower cell is always close to the hilum.

423a. ***Puccinia Holwayula*** Jackson, nom. nov.

*Puccinia Oyedaeae* Arth. Mycologia 10: 145. 1918 (Not Mayor, 1913).

*Dicaeoma Oyedaeae* Arth. & Jackson, N. Am. Fl. 7: 431. 1921.

In connection with the study of *Puccinia boliviana* (No. 420) the writer took occasion to examine the material on which the report of *P. Oyedaeae* Mayor, from Costa Rica, was based. It was found that the Costa Rican material was very different from *P. Oyedaeae* in urediniospore characters. Mayor described only teliospores, and interpreted his species as a leptiform. A few urediniospores are, however, present in the telia of the type material. These are depressed globoid, 18-21  $\mu$  in diameter with 5-6 pores which are apparently subequatorial, but often appear scattered. The walls are thin and moderately echinulate. The urediniospores in the Costa Rican material are very different, being much larger, thick walled, prominently and coarsely verrucose-echinulate with scattered pores.

It would appear that three very distinct species having similar teliospores occur on *Oyedaea*. For the Costa Rican species the name *Puccinia Holwayula* is proposed. The type collection is on *Oyedaea acuminata* (Benth.) Benth. & Hook. f. and was made at San Jose, Costa Rica, Jan. 3, 1916, by E. W. D. Holway (No. 356). A full and adequate description drawn exclusively from the Costa Rican material will be found in the North American Flora (l.c.).

A specimen on *Oyedaea verbesinoides* DC. collected at Aserri, Costa Rica, by H. Sydow, and distributed as No. 589 in Sydow, Fungi exotici exsiccati, is the same as the collection from Costa Rica mentioned above, and is to be referred to this species.

424. PUCCINIA IRREGULARIS Dietel, Hedwigia 36: 33. Feb. 1897 (Not Ell. & Tr. June 1897).

*Verbesina boliviana* Klatt. Sorata, Bolivia, Apr. 25, 1920, 572.

The above collection seems best referred to this species for the present. The urediniospores agree well with the type. The teliospores, however, while very similar, lack the irregular character which gave this species its name. The telia in our collection are long covered by the epidermis, which is characteristic of the species.

425. PUCCINIA MADIAE Sydow, Monog. Ured. 1: 121. 1902.

*Madia chilensis* (Nutt.) Reiche, Baños de Cauquenes, Rancagua, Chile, Jan. 15, 1920, 297.

*Madia sativa* Mol. Baños de Cauquenes, Rancagua, Chile, Jan. 13, 1920, 291; Branden Copper Mines, Rancagua, Chile, Jan. 20, 1920, 300.

*Madia* sp. Panimávida, Chile, Dec. 15, 1919, 231; Zapallar, Chile, Jan. 31, 1920, 301.

It seems best for the purposes of this account to report these collections under the above name, which was based on material from Chile, and is certainly correct. In North America, the name in present use is *P. nuda* E. & E. (See N. Am. Fl. 7: 598. 1922). It seems probable that the species should be combined with others on related hosts, as has been done for the North American collections.

426. PUCCINIA MINUSCULA Arth. Bull. Torrey Club 51: 56. 1924.

*Helianthus hypargyreus* Blake, Huigra, Chimborazo, Ecuador, Aug. 3, 1920, 815; Cuenca, Ecuador, Sept. 10, 1920, 971.

A distinct species originally reported from the same locality as the first specimen listed above, and on the same host.

427. *Puccinia obrepta* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis, in maculis decoloratis subhy-pertrophicis crebre aggregatis, nigricantibus, punctiformibus, parum variabiliter globosis vel ellipsoideis, 110–180  $\mu$  latis, 135–180  $\mu$  altis; periphysibus fasciculum humilem compactumque efformantibus.

I. *Aecidiis* epiphyllis, pycnidia circumdantibus, in greges 3-8 congregatis, parvis, .35-.5 mm. diam., soro flavescenti et peridio albo conspicue adulto membranaceo lacerato praeditis; cellulis peridialibus e facie irregulariter polygonis,  $22-30 \times 36-45 \mu$ ; tunica intus extusque tenui, collabescente, intus crebre minuteque verrucosa; aecidiosporis ellipsoideis,  $18-24 \times 24-32 \mu$ , tunica pallide aurato-flava  $1.5-2 \mu$  crebre minuteque verrucoso-tuberculata instructis.

II. *Uredosoris* hypophyllis, sparsis, parvis, rotundatis, 0.2-0.4 mm. diam., mox nudis, pulverulentis, cinnamomeo-brunneis, epidermide rupta plerumque visibiliter cinctis; uredosporis late depresso sphaeroideis, infra ut plurimum leniter depressis,  $22-24 \mu$  altis,  $24-27 \mu$  latis; tunica castaneo-brunnea,  $2-2.5 \mu$  cr., minute echinulata, verrucis moderate inter se remotis praedita; poris 5-7, sparsis vel 4-5 in zona aequatoriali vel subaequatoriali et 1-2 supra dispositis.

III. *Teleutosoris* hypophyllis, sparsis, parvis, rotundatis, 0.2-0.6 mm. diam., castaneo-brunneis, dein germinando cinereis, mox nudis, compactis, applanatis, tandem pulvinatis; epidermide rupta in soris junioribus solis visibili; teleutosporis ellipsoideis, oblongis vel subclavatis,  $21-28 \times 42-60 \mu$ , supra rotundatis, infra rotundatis vel subangustatulis, septo leniter vel non constrictis; tunica castaneo-brunnea, saepe infra pallidior,  $1.5-3 \mu$ , angulis cellulae inferioris apiceque cellulae superioris ad  $6-9 \mu$  crassata, levi; pedicello hyalino, sporam aequante vel duplo longiore vel etiam brevior.

*Wedelia isolepis* Blake, Sorata, Bolivia, Apr. 14, 1920, 517 (type).

*Wedelia* sp. Sorata, Bolivia, Apr. 25, 1920, 570.

This species is one of a series occurring in South America on *Wedelia* having several uredinial wall pores and teliospores with apices thickened appreciably at the apex. It differs from *P. sub-aquila* (See No. 433) in the number and arrangement of the urediniospore pores and from *P. ecuadorensis* Arth. in the much greater thickening of the apex of the teliospore wall. In the description of the latter species, the apical thickening is given as  $3-5 \mu$ . An examination of the type shows that the thickening is very slight, rarely, if ever, over  $3 \mu$ . The species is therefore very close to *P. caracasana* Sydow, which may, when carefully compared, prove to be synonymous.

The several species of *Puccinia* occurring on *Wedelia*, three of which are described in this paper, may be separated as follows:

Uredinia present.

Urediniospore wall pores two, aecia without peridia. 435. *P. wedeliicola*.

Urediniospore wall pores three or more, aecia, where known, with well developed peridia.

Teliospores only slightly thickened at apex, 3  $\mu$  or less.

Urediniospore wall pores 4 equatorial. . . . . *P. caracasana*.

Urediniospore wall pores 6 scattered. . . . . *P. ecuadorensis*.

Teliospores appreciably thickened at apex, 5  $\mu$  or more.

Urediniospore wall pores 5-7 scattered. . . . . 427. *P. obrepita*.

Urediniospore wall pores 3-4 equatorial. . . . . 433. *P. subaquila*.

Uredinia absent; micro-form. . . . . *P. Wedeliae*.

428. ***Puccinia partheniicola*** Jackson, nom. nov.

? *Uredo Parthenii* Speg. Anal. Mus. Nac. Buenos Aires 6: 239. 1899 (Not *P. Parthenii* Arth. 1910).

II. Uredosoris epiphyllis et cauliculis sed quandoque hypophyllis, soris foliiculis magnis rotundatis 0.4-0.8 mm. diam. saepe confluentibus sed soris cauliculis elongatis 1-5 mm. praeditis, tardius nudis, cinnamomeo-brunneis, pulverulentis, epidermide rupta cinctis; uredosporis obovatis vel cuneatis (?), 22-24  $\times$  23-27  $\mu$ , pariete cinnamomeo- vel pallide castaneo-brunneo 2-2.5  $\mu$  cr. minute moderateque echinulato instructis; poris, duobus vel tribus, subaequatorialibus vel duobus subaequatorialibus et uno apicali.

III. Teleutosoris epiphyllis vel cauliculis, uredosoris conformibus, compactis, nigricantibus; teleutosporis 27-30  $\times$  30-36  $\mu$ , utrinque rotundatis, septo non constrictis; tunica theobromina, 5-6  $\mu$  cr., ad apicem umbone lato pallidioreque usque 9  $\mu$  incrassata, levi; pedicello hyalino, longo, persistenti, in longitudine sporam triplo vel quadruplo superante vel brevior.

*Parthenium Hysterophorus* L. Cochabamba, Bolivia, Feb. 29, 1920, 349 (type).

*Viguiera Pflanzii* Perkins, La Paz, Bolivia, March 19, 1920, 424.

In a previous publication (Mycologia 14: 109. 1922) the writer has expressed the opinion that *Puccinia Parthenii* Arth. and *Uredo Parthenii* Speg. were not synonymous. Arthur's combination was based on material collected in Mexico on *Parthenium argentatum* A. Gray. Teliospores are known in North America only on that host. The urediniospores of Mexican collections on *P. Hysterophorus* L., the type host of Spegazzini's species, are

quite different from those on *P. argentatum*. The type of *Uredo Parthenii* has, however, not been available for comparison.

In the collections listed above, one of which is on *P. Hysterophorus*, the urediniospores agree with Mexican collections on the same host. The teliospores are quite different from the teliospores on *P. argentatum*. For these reasons it seems best to use a new name for this species. It seems quite likely that *Uredo Parthenii* Speg. will prove to be synonymous, though this is not certain. The rusts on the two hosts listed above show identical characters, except that the collection on *Viguiera* consists mostly of epiphyllous and caulicolous telia, while the type collection shows mostly uredinia on the leaves and both uredinia and telia on the stems.

429. ***Puccinia Polymniae*** Jackson & Holway, sp. nov.

II. *Uredosoris* amphigenis sed plerumque hypophyllis, sparsis vel gregariis, rotundatis vel irregularibus, 0.2–0.8 mm. diam., castaneo-brunneis, mox nudis, pulverulentis; epidermide rupta plerumque visibili; uredosporis depresso globosis, 21–24  $\mu$  altis, 26–32  $\mu$  latis; tunica castaneo-brunnea, 1.5–2  $\mu$  cr., minute echinulata, verrucis inter se moderate remotis; poris 4, subaequatorialibus.

III. *Teleutosoris* hypophyllis, sparsis, rotundatis, 0.2–0.4 mm. diam., nitide castaneo-brunneis, dein germinando theobrominis cinereisque, mox nudis, compactis, applanatis, dein pulvinatis; epidermide rupta non visibili; teleutosporis parum irregulariter ellipsoideis vel clavatis, 24–30  $\times$  48–60  $\mu$ , supra rotundatis vel obtusis, infra ad basim rotundatis vel contractis, septo non vel leniter constrictis; tunica infra aurato- sed supra pallide castaneo-brunnea, 1–1.5  $\mu$  cr. in cellula inferiore sed in cellula superiore crassiore, apice paulatim ad 3–6  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Polymnia glabrata* DC. Sorata, Bolivia, Apr. 21, 1920, 558 (type).

*Polymnia eurylepis* Blake, Cuenca, Ecuador, Sept. 10, 1920, 974.

A distinct species separable because of the vertically flattened urediniospores with four sub-equatorial pores. The teliospores are somewhat irregular. The pore of the lower cell is at the septum and that of the upper cell often depressed so that it appears at one side of the apical thickening.

The second collection listed bears uredinia only, the spores of which agree with the type collection.

This is probably the same species as that reported by Pennington (Anal. Soc. Cient. Argent. **53**: 264. 1902) as *Puccinia Helianthi* Schw., on *Polymnia auriculata*.

*Uredo Polymniae* P. Henn. is the uredinial stage of *Uromyces Polymniae* (P. Henn.) Dietel & Holway. A few typical teliospores are present in the type specimen. The urediniospores of that species are quite different from those in the species described above, being smaller, not depressed and with two equatorial pores.

430. *PUCCINIA SPILANTHICOLA* Mayor, Mém. Soc. Neuch. Sci. Nat. **5**: 531. 1913.

*Spilanthes ocymifolia radiifera* A. H. Moore, Nictheroy, Rio de Janeiro, Brazil, Dec. 27, 1921, 1430; Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 10, 1922, 1839.

*Spilanthes uliginosa* Sw. Cascadura, Rio de Janeiro, Brazil, Jan. 12, 1922, 1472.

These collections seem best referred to this species, rather than to *P. Spilanthis* P. Henn. The species has previously been reported only from Colombia. Mesospores are present, but usually not in the high proportion found in the Colombian collections.

431. *PUCCINIA SPLENDENS* Vize, Grevillea **7**: 11. 1878.

*Puccinia Franseriae* Sydow, Ann. Myc. **1**: 326. 1903.

*Franseria artemisioides* Willd. Quito, Ecuador, Sept. 2, 1920, 957; Cuenca, Ecuador, Sept. 10, 1920, 979.

These collections seem to agree sufficiently well with the North American species to justify the identification given above. There are slight differences, but these do not seem to be sufficient to warrant separation. The species is known otherwise only from the South Western United States.

432. *PUCCINIA STEIRACTINIAE* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis, pyriformibus vel oblongis, 165–210  $\mu$  latis, 240–270  $\mu$  altis; periphysibus late humiliterque fasciculatis.

I. *Aecidiis* epiphyllis, singulatim saepe sine pycnidiis vel gregatim in maculis leniter hypertrophicis dispositis, parvis, profunde insidentibus, 200–400  $\mu$  diam., soro flavido et peridio conspicue adulto albo membranaceo primum cylindraceo dein irregulariter lacerato praeditis; loculis peridialibus e facie visis irregulariter polygonalibus, 24–30  $\times$  40–48  $\mu$ ; tunica intus extusque tenui, collabescente, interiore minutissime et creberrime verrucosa; aecidiosporis subglobosis vel angulato-ellipsoideis, 22–26  $\times$  26–32  $\mu$ , tunica flavescenti 2–3  $\mu$  cr. prominenter sed minutius verrucoso-tuberculata praeditis.

II. *Uredosoris* hypophyllis, sparsis, rotundatis, 0.2–0.4 mm. diam., pallide castaneo-brunneis, mox nudis, pulverulentis, epidermide rupta non conspicue cinctis; uredosporis apparenter globosis, 23–25  $\mu$  diam., sed vero in latere inferiore parum depressis; tunica castaneo-brunnea, 2–2.5  $\mu$  cr., in latere depresso circa hilum tenuiore, minute echinulata, verrucis inter se moderate remotis; poris 6–8 vel pluribus, sparsis.

III. *Teleutosoris* hypophyllis, sparsis vel gregariis, parvis, rotundatis, 0.2–0.4 mm. diam., mox nudis, castaneo-brunneis, dein germinando parum cinerascentibus, compactis, tandem pulvinatis; epidermide rupta non visibili; teleutosporis lineari-cylindraceis, 18–24  $\times$  85–135  $\mu$ , septo ut plurimum visibiliter constrictis; tunica pallide castaneo-brunnea, infra pallidiore, 1–2.5  $\mu$  cr., apice ad 10–15  $\mu$  magnopere incrassata et subbulbacea, contra porum cellulae inferioris saepe ad 4  $\mu$  incrassata, levi; pedicello incolori, flexuoso, sporam longitudine aequante vel brevior.

*Steiractinia Rosei* Blake, Huigra, Chimborazo, Ecuador, Aug. 4, 1920, 832.

This species is remarkable because of the extremely long, narrow teliospores. The thickened apex is often somewhat wider than the upper portion of the cell just below, giving the spore a characteristic appearance. The urediniospores are flattened slightly below, and there are 6–10 scattered pores.

433. *Puccinia subaquila* Jackson & Holway, sp. nov.

II. *Uredosoris* hypophyllis, sparsis, parvis, rotundatis, 0.2–0.4 mm. diam., aurato-brunneis, mox nudis, pulverulentis, epidermide rupta cinctis; uredosporis apparenter globosis sed vero depresse globosis vel ellipsoideis, hilo in uno latere insito praeditis, 18–21  $\mu$  altis, 24–27  $\mu$  latis; pariete pallide cinnamomeo- vel aurato-brunneo, 1.5–2  $\mu$ , minutius crebreque echinulato, poris typice 3–4, aequatorialibus vel parum subaequatorialibus sed in sporis paucis 5, uno ex quorum apice insidente.

III. Teleutosoris hypophyllis, sparsis, rotundatis, 0.2-0.5 mm. diam., nigricantibus, mox nudis, compactis, dein subpulvinatis, epidermide rupta inconspicue cinctis; teleutosporis ellipsoideis vel subclavatis, supra rotundatis, infra rotundatis vel contractis, septo vix constrictis, tunica castaneo-brunnea 2-4  $\mu$  cr. apice ad 7-12  $\mu$  magnopere incrassata levi praeditis; pedicello hyalino, firmo, 9  $\mu$  diam., sporam aequante vel dimidio superante sed plerumque brevior.

*Wedelia helianthioides* H.B.K. Choisica, Peru, July 23, 1920, 792; Huigra, Chimborazo, Ecuador, Aug. 4, 1920, 833.

*Wedelia Holwayi* Blake, Cochabamba, Bolivia, March 7, 1920, 376 (type).

This species differs from *P. obrepta* (cf. No. 427) in several details. The teliospores are somewhat shorter and broader, with darker, thicker walls, not germinating. The urediniospores have lighter colored, thinner walls, and the pores are characteristically 3 or 4, equatorial. The two species are clearly related, but differ sufficiently to justify separation. The collections on *Wedelia helianthioides* are referred here provisionally. The teliospores are much the same, but the urediniospores have dark, thick walls, with 3 equatorial pores.

434. ***Puccinia Verbesinae-dentatae*** (Sydow) Jackson & Holway, comb. nov.

*Uredo Verbesinae-dentatae* Sydow, Oesterr. Bot. Zeitschr. 52: 185. 1902.

*Verbesina adenobasis* Blake, Cuenca, Ecuador, Sept. 15, 1920, 991.

*Verbesina brachypoda* Blake, Cuenca, Ecuador, Sept. 12, 1920, 983.

*Verbesina glabrata* H. & A. Petropolis, Brazil, Oct. 26, 1921, 1250.

*Verbesina* (near *V. glabrata* H. & A.) Ribeirão Pires, São Paulo, Brazil, March 25, 1922, 1678.

*Uredo Verbesinae-dentatae* Syd. was based on material collected in Ecuador, on *V. dentata* H.B.K. The collections listed above from Ecuador agree well with this species. In collection 983 a few telia were found on one leaf. These are pulvinate, light



chestnut brown, germinating at once. The teliospores are long cylindrical  $18-24$  by  $75-120\ \mu$ , usually tapering somewhat at both ends and strongly constricted at the septum. The lower cell is usually longer and narrower than the upper. The wall is golden brown, thin  $1-1.5\ \mu$ , not thickened at the apex, except very slightly so at the sides of the pore. The pedicels are colorless, equalling the spore or shorter. The character of the teliospores makes this a very distinct one among *Verbesina* rusts.

The collections from Brazil have somewhat similar urediniospores and are referred here tentatively.

435. *Puccinia wedeliicola* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, in gregem densum  $4-8$  aggregatis, maculis decoloratis sed vix hypertrophicis insidentibus, prominulis, punctiformibus, nigrescentibus, globosis vel depresso globosis,  $105-135\ \mu$  latis,  $90-120\ \mu$  altis; periphysibus fasciculum densum  $45-60\ \mu$  altum efformantibus.

I. Aecidiis epiphyllis, plerumque orbiculatim circum pycnidia aggregatis, caematiformibus, tarde nudis, pulverulentis, epidermide rupta cinctis, soro albedo praeditis, peridio carentibus; aecidiosporis ellipsoideis, saepe subirregularibus,  $18-21 \times 24-36\ \mu$ , tunica hyalina  $2-3\ \mu$  cr. crasse crebreque verrucoso-tuberculata instructis.

II. Uredosoris hypophyllis, sparsis, rotundatis,  $0.3-0.5$  mm. diam., cinnamomeo-brunneis, mox nudis, pulverulentis, epidermide rupta visibiliter cinctis; uredosporis parum irregulariter globosis vel obovatis,  $21-24 \times 21-27\ \mu$ ; tunica castaneo-brunnea,  $1.5-2\ \mu$ , minute sparsiusque echinulata, poris 2 aequatorialibus praedita.

III. Teleutosoris hypophyllis, sparsis, castaneo-brunneis, dein germinando cinerascentibus, mox nudis, compactis, applanatis, tandem subpulvinatis; epidermide rupta plerumque non visibili; teleutosporis ellipsoideis, oblongis vel clavatis,  $16-24 \times 42-54\ \mu$ , supra rotundatis, infra pedicellum versus rotundatis vel contractis, leniter medio constrictis; tunica in cellula inferiore aurato-brunneola,  $1-1.5\ \mu$  cr., sed in cellula superiore castaneo-brunnea,  $1.5-2.5\ \mu$  cr., ad apicem usque  $6-9\ \mu$  umbone lato pallideque flavescenti incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Wedelia trichostephia* DC. Reserva Florestal, Itatiaya, Rio de Janeiro, Brazil, May 7, 1922, 1822.

This species is quite different from others on *Wedelia* having

thickened apices to the teliospores; on account of the number of pores in the urediniospore wall and the entire absence of a peridium in the aecium.

436. *Uromyces Aspiliae* Jackson & Holway, sp. nov.

O, I. Pycnidiis et aecidiis incognitis.

II. Uredosoris hypophyllis, sparsis vel gregariis, rotundatis, 0.3–0.5 mm. diam., mox nudis, cinnamomeo-brunneis, pulverulentissimis; epidermide rupta inconspicua; uredosporis obovatis vel ellipsoideis vel subtriangularibus,  $21-24 \times 24-27 \mu$ ; pariete pallide castaneo-brunneo,  $1.5-2 \mu$  cr., minute echinulato, verrucis inter se remotis; poris 2, aequatorialibus.

III. Teleutosoris hypophyllis, sparsis vel gregariis, rotundatis, 0.3–0.5 mm. diam., brunneo-nigrescentibus vel castaneo-brunneis, germinando cinerascentibus, mox nudis, compactis, applanatis, dein pulvinatis; epidermide rupta non visibili; teleutosporis ellipsoideis vel obovatis, saepe parum irregularibus,  $18-24 \times 27-36 \mu$ , supra rotundatis vel subobtusis, infra rotundatis vel subangustatis; tunica castaneo-brunnea,  $1.5-2.5 \mu$  cr., apice umbone parum pallidiore latoque magnopere incrassata ad  $8-12 \mu$ , levi; pedicello hyalino, flexuoso, duplo sporam superante vel saepius brevior.

*Aspilia phyllostachya* Baker, Petropolis, Rio de Janeiro, Brazil, Nov. 3, 1921, 1271.

437. *UROMYCES BIDENTICOLA* (P. Henn.) Arth. Mycologia 9: 71. 1917.

*Uredo Bidentis* P. Henn. Hedwigia 35: 251. 1896 (Not *U. Bidentis* Lagerh. 1895).

*Puccinia Bidentis* Dietel & Holway; Holway, Bot. Gaz. 24: 32. 1897.

*Uredo bidenticola* P. Henn. Hedwigia 37: 279. 1898.

*Uredo amaniensis* P. Henn. Bot. Jahrb. 38: 106. 1905.

*Uredo bidenticola* Speg. Rev. Argent. de Bot. 1: 134. 1925.

*Bidens andicola* H.B.K. La Paz, Bolivia, March 24, 1920, 450; Sorata, Bolivia, Apr. 26, 1920, 575.

*Bidens macrantha* Griseb. Cochabamba, Bolivia, March 14, 1920, 410.

*Bidens pilosa* L. San Felipe, Sur Yungas, Bolivia, May 19, 1920, 623; Rio de Janeiro, Brazil, Aug. 12, 1921, 1023.

*Bidens rubifolia* H.B.K. var. Juiz de Fora, Minas Geraes, Brazil, Dec. 17, 1921, 1407.

*Bidens* sp. Petropolis, Rio de Janeiro, Brazil, Nov. 3, 1921, 1276; Campos do Jordão, São Paulo, Brazil, May 1, 1922, 1796; Cuzco, Peru, July 1, 1920, 749.

Several of the collections here reported show primary uredinia; all show uredinia. Whether or not this species should be united with *U. Bidentis* Lagerh. is an open question. It is possible that the species is a mutable one, in which uredinia do not always appear following basidiospore infection. We have preferred to keep the two forms separate for the present, and list as *U. Bidentis* Lagerh. those collections which show a strictly microcyclic condition.

438. *UROMYCES BIDENTIS* Lagerh. Bull. Soc. Myc. Fr. 11: 213. 1895.

*Uromyces densus* Arth. Mycologia 7: 196. 1915.

*Bidens pilosa* L. Rio de Janeiro, Brazil, Aug. 17, 1921, 1048, Nov. 13, 1921, 1299.

*Bidens* sp. Villa Aspiazu, Sur Yungas, Bolivia, June 1, 1920, 698; Therezopolis, Rio de Janeiro, Brazil, Sept. 28, 1921, 1166.

439. *UROMYCES BLAINVILLEAE* Berk. Jour. Linn. Soc. Bot. 14: 92. 1875.

*Uredo Gaudichaudii* Sydow, Ann. Myc. 1: 21. 1903.

*Blainvillea dichotoma* (Murr.) Cass. Jardim Botânico, Rio de Janeiro, Brazil, Aug. 11, 1921, 1018; Nictheroy, Rio de Janeiro, Brazil, Aug. 18, 1921, 1054; Còpacabana, Rio de Janeiro, Brazil, Sept. 21, 1921, 1131.

440. *Uromyces sphaericus* Jackson & Holway, sp. nov.

O, I. Pycnidiis et aecidiis incognitis.

II. Uredosoris amphigenis, sparsis vel gregariis, rotundatis, 0.4-1.0 mm. diam., cinnamomeo-brunneis, mox nudis, pulverulentis; epidermide rupta visibili; uredosporis globosis vel late ellipsoideis, 21-24 × 24-27  $\mu$ ; tunica aurato-brunnea, 2.5-3.5  $\mu$  cr., minute echinulata, verrucis inter se moderate secernatis; poris 4-6, sparsis.

III. Teleutosoris amphigenis, uredosoris conformibus, brunneo-nigrescentibus, pulverulentis; teleutosporis depresso globosis, 20–24  $\mu$  e pedicello ad apicem longis, 24–28  $\mu$  latis; tunica parum opaca, theobromina, 3–5  $\mu$  cr., apice late obscureque umbonata ad 6  $\mu$ , crebre prominenterque verrucoso-echinulata, umbone solo levi; pedicello hyalino, flexuoso, plerumque persistenti, 45  $\mu$  longo vel saepius brevior.

*Perymenium ecuadoricum* Blake, Huigra, Chimborazo, Ecuador, Aug. 3, 1920, 828.

441. UROMYCES WULFFIAE-STENOGLOSSAE Dietel, Ann. Myc. 6: 96. 1908.

*Wulffia maculata* (Ker) DC. Juquery, São Paulo, Brazil, Feb. 14, 1922, 1557; Taquara, Rio de Janeiro, Brazil, Aug. 30, 1921, 1086.

*Wulffia maculata oblongifolia* (DC.) Schulz, Rio de Janeiro, Brazil, Sept. 21, 1921, 1137; Novo Friburgo, Rio de Janeiro, Brazil, Jan. 2, 1922, 1441.

*Wulffia* sp. Tremembé, São Paulo, Brazil, May 30, 1922, 1906.

442. **Uredo irrequisita** Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, rotundatis, 0.2–0.4 mm. diam., castaneo-brunneis, mox nudis, pulverulentissimis; epidermide fissa plerumque non visibili; uredosporis ellipsoideis, 23–25  $\times$  26–30  $\mu$ ; tunica castaneo-brunnea, 2.5–3  $\mu$  cr., minutissime crebreque verrucoso-echinulata, areis levibus circum supraque poros instructa, poris 2 subaequatorialibus praedita.

*Verbesina dentata* (H. & B.) H.B.K. Riobamba, Ecuador, Aug. 10, 1920, 868.

*Verbesina Hallii* Hieron. Riobamba, Ecuador, Aug. 10, 1920, 866; Quito, Ecuador, Aug. 19, 1920, 920 (type).

*Verbesina Mandonii* Sch. Bip. La Paz, Bolivia, March 24, 1920, 455.

*Verbesina* sp. Urubamba, Urubamba Valley, Cuzco, Peru, July 3, 1920, 758.

In the description given above, the wall thickness is described as it appears when the pores are in face view, that is when the axis of the two pores is vertical as viewed under the microscope. When the spore is slightly turned, so that this axis is oblique,

the wall appears thick above and below, but quite thin at the sides. When the pores are in optical section, that is, when the axis between the pores is horizontal, the wall appears to be thickened on both sides, as well as above and below, leaving four thin spots, two above and two below, between the thickened sides and the thickened apex and base. This gives the spores a very characteristic appearance. No teliospores could be found in any of the collections, all of which appear to be on related hosts.

443. *Uredo Monactidis* Jackson & Holway, sp. nov.

II. *Uredosoris amphigenis* sed praecipue hypophyllis, sparsis, rotundatis, 0.2–0.5 mm. diam., mox nudis, pallide cinnamomeo-brunneis, pulverulentis; epidermide rupta visibili; uredosporis globosis vel depresso globosis, 23–27  $\mu$  latis, 21–24  $\mu$  altis; tunica cinnamomeo- vel castaneo-brunnea, plerumque supra obscuriore, infra 1–1.5  $\mu$  cr., supra ad 2.5  $\mu$  paulatim incrassata, minute crebreque echinulata; poris parum obscuris, 3–4, aequatorialibus vel leniter subaequatorialibus.

*Monactis subdeltoidea* Rob. Quito, Ecuador, Aug. 28, 1920, 948.

444. *Uredo verbesinicola* Jackson & Holway, sp. nov.

II. *Uredosoris hypophyllis*, sparsis, rotundatis, 0.2–0.5 mm. diam., pallide castaneo-brunneis, mox nudis, pulverulentis; epidermide rupta plerumque inconspicua; uredosporis ellipsoideis vel obovatis, 21–24  $\times$  30–36  $\mu$ ; tunica inaequaliter incrassata, castaneo-brunnea, areas duas latas 3–3.5  $\mu$  cr. utrinque efformante itaque anulum aequatorialem irregulariter tenuem pallidiorem 1–1.5  $\mu$  cr. efficiente, minute crebreque echinulata; poris obscuris, 2 pluribusve, in annulo aequatoriali et tenui positis.

*Verbesina Hallii* Hieron. Quito, Ecuador, Aug. 19, 1920, 922A.

A striking species quite different from the *Uredo* of any of the numerous species of *Puccinia* described on this host. The spores are thickened so as to form two caps covering the upper and lower third of the spore, having a broad, irregular, thin band at the equator. The pores are obscure. Two can be seen clearly, but there seem to be more in some spores.

## SPECIES ON CARDUACEAE

## (Tribe Heleneae)

445. *Puccinia indecorata* Jackson & Holway, sp. nov.

O. Pycnidiis non visis, probaliter carentibus.

I. Aecidiis epiphyllis, plerumque singulatim vel in greges 2-3 dispositis, parvis, cupulatis, peridio albo breviter cylindraceo tandem lacerato membranaceo instructis; cellulis peridialibus e facie irregulariter polygonis,  $18-24 \times 30-45 \mu$ ; tunica extus intusque tenui, collabescente, interiore moderate verrucoso-tuberculata; aecidiosporis subglobosis vel ellipsoideis,  $21-24 \times 24-28 \mu$ , tunica hyalina  $1-2.5 \mu$  minute crebreque verrucosa instructis.

III. Teleutosoris amphigenis sed utplurimum hypophyllis, sparsis, rotundatis, 0.2-0.4 mm. diam., castaneo-brunneis, tandem germinando cinerascens, mox nudis, compactis, applanatis, dein pulvinatis, epidermide rupta inconspicuis; teleutosporis ellipsoideis, oblongis vel clavatis,  $20-24 \times 40-65 \mu$ , supra rotundatis vel obtusis, infra rotundatis vel saepius contractis, septo non vel leniter constrictis; tunica aurato-brunnea,  $1-1.5 \mu$  cr., apice ad  $5-9 \mu$  incrassata, levi; pedicello hyalino, sporam aequante vel saepius brevior.

*Tagetes graveolens* Sch. Bip. Sorata, Bolivia, Apr. 12, 1920, 506.

*Tagetes Mandonii* Sch. Bip. Sorata, Bolivia, Apr. 11, 1920, 502 (type).

*Tagetes micrantha* Cav. Sorata, Bolivia, Apr. 29, 1920, 581.

The collection on *Tagetes graveolens* has caulicolous aecia as well as the scattered form on the leaves. The peridial cells are much longer and more slender and the aeciospores somewhat larger. The teliospores are, however, the same as in the collection selected as the type.

No urediniospores could be found in any of the collections, which suggests that the species is an -opsis form.

446. *Puccinia tagetica* Dietel & Holway, Bot. Gaz. 24: 26. 1897.

*Tagetes pusilla* H.B.K. Sorata, Bolivia, Apr. 11, 1920, 500.

A common rust in Central America and the West Indies, which has previously been reported from South America only from Colombia.

447. *PUCCINIA POROPHYLLI* P. Henn. Hedwigia Beibl. **39**: 153. 1900.

*Porophyllum rudera* (Jacq.) Cass. Poá, São Paulo, Brazil, March 11, 1922, 1625.

This species was originally collected in Venezuela, and is also known from Mexico.

SPECIES ON CARDUACEAE

(Tribe Senecioneae)

448. *ACIDIUM LIABI* Mayor, Mém. Soc. Neuch. Sci. Nat. **5**: 576. 1913.

*Aecidium Liabi* Arth. Bull. Torrey Club **47**: 479. 1920.

*Liabum hastifolium* P. & E. Villa Aspiazu, Sur Yungas, Bolivia, June 1, 1920, 694.

Originally described from Colombia, this species is also known from Southern Mexico.

449. *Aecidium quitensis* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, numerosis, in maculis primum flavescens, dein purpurascens, laxae aggregatis, prominentibus, punctiformibus, globosis vel ellipsoideis,  $120-180 \times 150-180 \mu$ ; periphysibus non extrusis.

I. Aecidiis hypophyllis, in greges 3-5 mm. diam. crebre gregatim dispositis, saepe circinnatis; peridio pallide flavido, longe, cylindrato, margine eroso praeditis; cellulis peridialibus e latere visis cubicis vel rectangulis vel subrhomboideis,  $21-28 \times 28-42 \mu$ , contiguas; tunica exteriori  $5-6.5 \mu$  cr., transverse striata, interiori  $5-6.5 \mu$  cr., minute crebreque sed parum prominenter tuberculata; aecidiosporis subglobosis vel irregulariter ellipsoideis,  $22-30 \times 30-40 \mu$ ; tunica incolori, tenui,  $1.5-2 \mu$ , apice ad  $12-18 \mu$  magnopere incrassata, minute crebreque verrucoso-tuberculata.

*Liabum igniarium* (H.B.K.) Less. Quito, Ecuador, Aug. 21, 1920, 932.

Though occurring on the same host as *Aecidium Liabi* Mayor, this species is strikingly different because of the greatly thickened apices of the aeciospore wall.

Holway's field notes indicate that this *Aecidium* may prove to be the aecial stage of *Puccinia oblongula* Jackson & Holway, on *Rynchospora* (See Mycologia **18**: 145. 1926).

450. *BAEODROMUS SENECTIONIS* Sydow, Monog. Ured. 3: 549. 1915.

*Chrysomyxa Senecionis* Lagerh. in herb.

*Senecio betonicaefolius* DC. Quito, Ecuador, Aug. 23, 1920, 938.

The type of this species was collected by Lagerheim near Chimborazo, Ecuador, on *Senecio* sp. There seems little doubt that our collection is the same. Pycnia accompany the telia in this material. They are epiphyllous, subepidermal, globoid or depressed globoid 100–135  $\mu$  wide by 90–105  $\mu$  high. Ostiolar filaments are not prominent.

451. *CHRYSOPORESA GYNOXIDIS* Lagerh. Ber. Deutsch. Bot. Ges. 9: 345. 1891.

*Gynoxys buxifolia* (H.B.K.) Cass. Quito, Ecuador, Aug. 23, 1920, 944.

*Gynoxys Hallii* Hieron. Quito, Ecuador, Aug. 14, 1920, 890.

*Gynoxys hypomalaca* Blake, Sorata, Bolivia, Apr. 22, 1920, 567.

*Gynoxys* sp. N. of Zaruma, Oro, Ecuador, Sept. 20, 1920, 997.

This very interesting species has apparently been previously known only from Lagerheim's original collections, all made in Ecuador. The collections listed above not only add two new hosts, but extend the range to include Bolivia.

452. *COLEOSPORIUM SENECTIONIS* (Pers.) Fries, Summa Veg. Scand. 512. 1849.

*Uredo farinosa Senecionis* Pers. Syn. Fung. 218. 1801.

*Uredo Senecionis* Schum. Enum. Pl. Saell. 2: 229. 1803.

*Senecio adenotrichius* DC. San Felipe, Chile, Sept. 25, 1919, 67.

*Senecio Berterianus* Colla, Papudo, Chile, Sept. 17, 1919, 32.

*Senecio brasiliensis* Less. Therezopolis, Rio de Janeiro, Brazil, Sept. 28, 1921, 1154; Campos do Jordão, São Paulo, Brazil, Apr. 22, 1922, 1753; Curitiba, Brazil, June 20, 1922, 1981.



*Senecio collinus* DC. La Paz, Bolivia, March 31, 1920, 487.

*Senecio grandis* Gardn. Itatiaya, Rio de Janeiro, Brazil, May 18, 1922, 1857.

*Senecio hastatus* Bong. Campos do Jordão, São Paulo, Brazil, Apr. 20, 1922, 1742.

*Senecio rudbeckiaefolius* Meyen & Walp. Cochabamba, Bolivia, Feb. 28, 1920, 343.

*Senecio vulgaris* L. Larrain Alcalde, Chile, Oct. 11, 1919, 101.

*Senecio* sp. Papudo, Chile, Sept. 20, 1919, 56; Lota, Chile, Oct. 28, 1919, 144; Between Oruso and Cochabamba, Bolivia, Feb. 23, 1920, 315; Cochabamba, Bolivia, March 5, 1920, 371; Sorata, Bolivia, May 5, 1920, 591; Cuzco, Peru, July 1, 1920, 748; Petropolis, Rio de Janeiro, Brazil, Oct. 16, 1921, 1224; Campos do Jordão, São Paulo, Brazil, Apr. 22, 1922, 1751, 1754; La Falda, Argentina, Apr. 15, 1922, 2030.

453. *Puccinia condigna* Jackson & Holway, sp. nov.

O, I. Pycnidiis et aecidiis ignotis.

II. Uredosoris hypophyllis, sparsis, subflavis, parvis, rotundatis, 0.2-0.4 mm. diam., mox nudis, pulverulentis; epidermide rupta plerumque aegre visibili; uredosporis globosis, 24-27  $\mu$  diam., tunica flavescenti tenui 1-1.5  $\mu$  minute crebriusque echinulata praeditis; poris obscuris, 4 pluribusve, adparenter sparsis.

III. Teleutosoris hypophyllis, sparsis, rotundatis, 0.2-0.5 mm. diam., nitide castaneo-brunneis, dein e germinatione cinerascentibus, compactis, applanatis, tandem pulvinatis; epidermide rupta non visibili; teleutosporis oblongis vel ellipsoideis, 24-30  $\times$  54-78  $\mu$ , supra rotundatis, infra rotundatis vel quandoque contractis, plerumque medio visibiliter constrictis; tunica cinnamomeo-brunnea, infra pallidior, tenui, 1.5-2  $\mu$ , apice ad 4-8  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel saepius brevior.

*Liabum Eggersii* Hieron. Cuenca, Ecuador, Sept. 10, 1920, 969.

454. *PUCCINIA LIABI* Mayor, Mém. Soc. Neuch. Sci. Nat. 5: 539. 1913.

*Liabum Eggersii* Hieron.? Huigra, Chimborazo, Ecuador, Aug. 3, 1920, 820.

*Liabum hastifolium* P. & E. San Felipe, Sur Yungas, Bolivia, May 21, 1920, 636; Hacienda La Florida, Sur Yungas, Bolivia, May 26, 1920, 656.

*Liabum hastatum* (Wedd.) Britton, San Felipe, Sur Yungas, Bolivia, May 19, 1920, 616.

*Liabum* sp. El Chaco, Sur Yungas, Bolivia, May 25, 1920, 647.

These collections, while showing considerable variation, seem best referred to one species for the present. This microcyclic species is known otherwise only from Colombia.

455. ***Puccinia majuscula*** Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, crebre gregariis, in maculis decoloratis insidentibus, prominentibus, punctiformibus, magnis, globosis vel depresso globosis vel ellipsoideis, 180–270  $\mu$  altis, 180–300  $\mu$  latis; periphysibus non prominentibus.

II. Uredosoris primariis epiphyllis, circum pycnidia aggregatis, rotundatis, 0.3–0.6 mm. diam., castaneo-brunneis, tarde nudis, non conspicue pulverulentis, epidermide inflata et poro irregulari aperta diu tectis; uredosoris secundariis primariis conformibus, hypophyllis, sparsis vel gregariis; uredosporis late ellipsoideis, 28–32  $\times$  42–48  $\mu$ ; tunica pallide castaneo-brunnea, 1.5–2.5  $\mu$  cr., valde sparseque echinulata, poris 3 aequatorialibus praedita.

III. Teleutosoris hypophyllis, sparsis vel gregariis, parvis, rotundatis, 0.2–0.4 mm. diam., tardius nudis, pallide castaneo-brunneis sed ob germinationem cinereis, applanatis, tandem pulvinatis; epidermide rupta plerumque non visibili; teleutosporis oblongis vel ellipsoideis vel subclavatis, 24–30  $\times$  60–90  $\mu$ , supra rotundatis vel obtusis, infra rotundatis vel angustatulis, septo plerumque valde constrictis; tunica cinnamomeo-brunnea, 1–1.5  $\mu$  cr., apice non sed in sporis paucis ad 2.5–3  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Senecio* sp. San Felipe, Sur Yungas, Bolivia, May 19, 1920, 625, May 19, 1920, 627 (type).

The collection first listed above differs from the type in having somewhat smaller urediniospores. These are all secondary. The teliospores are, however, much like the type. The two collections are on different species of *Senecio*.

This is one of a group of three apparently undescribed species having large urediniospores with sparsely echinulate wall markings. They are presumably all brachy-forms, though only the one here described shows primary uredinia.

The species may be separated as follows:

- Teliopores appreciably thickened above..... 456. *P. procerula*.  
 Teliopores essentially unthickened above.  
   Urediniospores with 3 equatorial pores, teliospores 60–  
     90  $\mu$  long..... 455. *P. majuscula*.  
   Urediniospores with 2 equatorial pores, teliospores 45–  
     72  $\mu$  long..... 457. *P. proluviosa*.

456. ***Puccinia procerula*** Jackson & Holway, sp. nov.

II. Uredosoris non visis; uredosporis teleutosoris immixtis, ellipsoideis, 24–30  $\times$  32–45  $\mu$ ; pariete pallide castaneo-brunneo, 1.5–2.5  $\mu$  cr., forte sparse echinulato; poris 2 vel quandoque 3, aequatorialibus.

III. Teleutosoris hypophyllis, sparsis vel gregariis, primum castaneo-brunneis, dein germinando cinerascentibus, mox nudis, applanatis, tandem pulvinatis; epidermide rupta non visibili; teleutosporis ellipsoideis vel oblongis vel subclavatis, 22–30  $\times$  48–65  $\mu$ , supra rotundatis, infra rotundatis vel subangustatis, medio leniter constrictis; tunica cinnamomeo-brunnea, tenui, 1–1.5  $\mu$ , supra poros umbone subhyalino ad 6–9  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel brevior.

*Senecio pellucidinervis* Sch. Bip. Itatiaya, Rio de Janeiro, Brazil, May 18, 1922, 1865.

This species differs from the preceding in the smaller teliospores and from both the preceding and the following species in having the teliospores with an abrupt umbo over the apical pore. In the germinated spores the umbo disappears, leaving a characteristic thickened collar around the germ pore.

457. ***Puccinia proluviosa*** Jackson & Holway, sp. nov.

II. Uredosoris epiphyllis, in maculis decoloratis singulatim dispositis, bullatis, castaneo-brunneis, 0.3–0.6 mm. diam., tarde nudis, non conspicue pulverulentis, epidermide inflata diu tectis; uredosporis ellipsoideis vel obovatis, 23–26  $\times$  32–38  $\mu$ , tunica pallide castaneo-brunnea 1.5–2  $\mu$  cr. sparse prominenterque echinulata et poris 2 aequatorialibus praeditis.

III. Teleutosoris hypophyllis, sparsis vel gregariis, 0.2–0.4 mm. diam., castaneo-brunneis, dein germinando cinereis, mox nudis, applanatis, tandem pulvinatis; epidermide fissa primo visibili; teleutosporis oblongo-clavatis vel ellipsoideis, 22–28  $\times$  45–72  $\mu$ , supra rotundatis, infra rotundatis vel contractis, septo constrictulis; tunica cinnamomeo- vel pallide castaneo-brunnea, in cellula inferiore 1–1.5  $\mu$  cr. sed in cellula superiore leniter paulatimque

ad 2–2.5  $\mu$  incrassata, levi; pedicello hyalino, sporam aequante vel saepius brevior.

*Senecio pellucidinervis* Sch. Bip. Campos do Jordão, São Paulo, Brazil, Apr. 24, 1922, 1767.

This species, while obviously related to the two preceding, differs markedly from *P. procerula* in that the teliospores are essentially unthickened at the apex, and from *P. majuscula* in the much smaller, narrower teliospores, as well as in uredinio-spore pore characters.

Whether or not the epiphyllous uredinia in this species are primary could not be determined. They are badly parasitized in our material and no pycnia could be detected.

458. *UROMYCES WERNERIAE* Lagerh. Bull. Soc. Myc. Fr. 11: 212 1895.

*Werneria nubigenia* H.B.K. Quito, Ecuador, Aug. 19, 1920, 923.

A characteristic microcyclic form that is apparently otherwise known only from the type collection, also from Ecuador.

459. *Uredo Gynoxidis* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis, parvis, rotundatis, 0.2–0.4  $\mu$  diam., pallide castaneo-brunneis, pulverulentis, mox nudis; minutiebus tomento hospitis obscuris; uredosporis ellipsoideis vel obovatis, 19–24  $\times$  28–34  $\mu$ ; tunica pallide castaneo-brunnea, 2–3  $\mu$  cr., quandoque utrinque crassiore, minute echinulata, verrucis inter se moderate sejunctis instructa, poris 2 aequatorialibus praedita.

*Gynoxys Hallii* Hieron. Quito, Ecuador, Aug. 14, 1920, 893.

460. *Uredo senecionicola* Jackson & Holway, sp. nov.

II. Uredosoris hypophyllis, sparsis vel gregariis, pallide castaneo-brunneis, tarde nudis, pulverulentis, epidermide rupta conspicue cinctis; uredosporis ellipsoideis vel obovatis, 22–28  $\times$  28–32  $\mu$ ; tunica pallide castaneo-brunnea, supra parum obscuriore, tenui, 1–1.5  $\mu$ , sparsissime et minutius echinulata, poris 3 aequatorialibus praedita.

*Senecio pimpinellaefolius* H.B.K. Quito, Ecuador, Sept. 2, 1920, 961.

## SPECIES ON CARDUACEAE

## (Tribe Mutisieae)

461. *Aecidium Chuquiraguae* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, numerosis, laxe gregariis, in maculis decoloratis sitis, prominentibus, punctiformibus, globosis, ellipsoideis vel oblongis, 100–135  $\mu$  latis, 120–180  $\mu$  altis; periphysibus fasciculum laxum 45  $\mu$  altum efformantibus.

I. Aecidiis hypophyllis, in areis 1–2 cm. diam. saepe confluentibus laxe gregatim insidentibus, peridio flavido conspicue adulto firmo breviter cylindraceo tandem lacerato instructis; cellulis peridialibus e latere visis rhomboideis, 14–16  $\times$  30–36  $\mu$ , subforte imbricatis; tunica exterior 2–3.5  $\mu$  cr., levi, interior 2–3  $\mu$ , crebre verrucoso-rugosa; aecidiosporis subglobosis vel ellipsoideis, 22–26  $\times$  28–36  $\mu$ , tunica hyalina 1.5–2  $\mu$  una fine ad 7–15  $\mu$  magnopere incrassata crebre et parum prominenter verrucosa praeditis.

*Chuquiragua* sp. Campos do Jordão, São Paulo, Brazil, Apr. 20, 1922, 1743.

No other *Aecidium* seems to have been reported on this host genus. The species appears to be quite characteristic, on account of the habit, and also because of the extreme thickening of the aeciospore wall at one end of the spore.

## 462. DIDYMOPSIS CHUQUIRAGUAE Dietel, Hedwigia 38: 255. 1899.

*Chuquiragua glabra multiflora* Baker, Therezopolis, Rio de Janeiro, Brazil, Oct. 15, 1921, 1218.

This very characteristic species was based on two collections on *Chuquiragua tomentosa* Baker, made by Ule, in Santa Catharina and Tijuca, Brazil. It seems not to have been otherwise reported.

## 463. PUCCINIA CRASSICUTIS Sydow, Monog. Ured. 1: 125. 1902.

*Mutisia viciaefolia* Cav. Cochabamba, Bolivia, Feb. 28, 1920, 344; La Paz, Bolivia, March 20, 1920, 440; Cuzco, Peru, June 30, 1920, 745.

The collections listed above seem to fit this species well. It was originally described from Bolivia on *Mutisia Clematis* L., and differs from others on this host genus in having the teliospore wall verrucose.

464. *Puccinia defecta* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, paucis in omni grege insidentibus, areas decoloratas et subhypertrophicas occupantibus, punctiformibus, prominentibus, primo flavidis, demum nigricantibus, globosis vel depressa globosis, 90–120  $\mu$  altis, 105–150  $\mu$  latis; periphysibus non extrusis.

III. Teleutosoris epiphyllis, gregariis et saepe in gregem 1–1.5 mm. diam. confluentibus, pycnidia circumdantibus, annulum perfectum saepe efformantibus, mox nudis, compactis, applanatis, tandem pulvinatis, castaneo-brunneis, dein germinando cinerascens, epidermide rupta in soris maturis non visibili; teleutosporis oblongis vel cylindraceis, 15–24  $\times$  60–105  $\mu$ , supra rotundatis vel obtusis sed infra plerumque truncatis, medio valde constrictis; tunica aurato-brunnea, tenui, 1–1.5  $\mu$ , ad apicem usque 3–5  $\mu$  incrassata, levi; pedicello hyalino, primum lato, 15  $\mu$ , mox collabescente et flexuoso, sporam dimidio superante vel brevior.

*Jungia rugosa* Less. Cuenca, Aguay, Ecuador, Sept. 15, 1920, 994.

This very characteristic microcyclic species is entirely epiphyllous. The pycnia are surrounded by the telia, often in a complete circle. It is quite different from *P. Jungiae* P. Henn.

465. *Puccinia subita* Jackson & Holway, sp. nov.

O. Pycnidiis epiphyllis, laxe gregariis, maculis decoloratis insidentibus, applanatis, 120–135  $\mu$  altis, 240–270  $\mu$  latis, poro aperitis, aperiphysatis.

II. Uredosoris amphigenis, sparsis vel gregariis, cinnamomeo-brunneis, parvis, rotundatis, 0.2–0.4 mm. diam., tarde nudis, pulverulentis, epidermide rupta cinctis; uredosporis globosis, 29–31  $\mu$  diam., vel quandoque ellipsoideis, 27–30  $\times$  30–32  $\mu$ ; tunica aurato-brunnea, 2–3  $\mu$  cr., crebre tenuiter verrucosa, poris 6 sparsis praedita.

III. Teleutosoris amphigenis, sparsis vel gregariis, parvis, rotundatis, 0.2–0.4 mm. diam., castaneo-brunneis, dein ob germinationem cinereis, compactis, applanatis, tandem subpulvinatis, epidermide rupta non visibili; teleutosporis ellipsoideis vel oblongis vel clavatis, 26–30  $\times$  48–75  $\mu$ , supra rotundatis, infra rotundatis vel attenuatis, septo leniter vel non constrictis; pariete pallide castaneo-brunneo, tenui, 1–2  $\mu$ , apice ad 5–7  $\mu$  incrassato, levi, fine incrassata sola recte rugosa; pedicello hyalino, flexuoso, sporam duplo superante vel brevior.

*Mutisia sagittifolia* Blake, Quito, Ecuador, Aug. 23, 1920, 941.

A very different species from *P. Mutisiae* Lag., and separable from *P. mutisiicola* Speg. by the greatly thickened apices of the teliospores.

## SPECIES ON CARDUACEAE

(Tribe Cichorieae)

466. PUCCINIA CICHORII (DC.) Bellynck; Kickx. Fl. Crypt. Fland. 2: 65. 1867.

*Uredo Cichorii* DC. Fl. Fr. 6: 74. 1815.

*Caeoma Cichorii* Link, in Willd. Sp. Pl. 6: 18. 1825.

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*Cichorium Intybus* L. Panimávida, Chile, Dec. 12, 1919, 220;  
Emsenada, Lago Llanquihue, Chile, Nov. 28, 1919, 189;  
Valdivia, Chile, Nov. 13, 1919, 173.

467. PUCCINIA HIERACII (Schum.) Mart. Fl. Mosq. 226. 1817.

*Uredo Hieracii* Schum. Enum. Pl. Saell. 2: 233. 1803.

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*Hieracium pazense* Blake, La Paz, Bolivia, March 19, 1920, 425.

*Hieracium* sp. La Paz, Bolivia, March 26, 1920, 467.

The four species on Cichorieae might perhaps all be included under the above name. For the purposes of this account, however, it has seemed desirable to list them separately.

468. PUCCINIA HYPOCHAERIDIS Oud. Nederl. Kruidk. Arch. II 1: 175. 1872.

*Hypochaeris glabra* L. Vina del Mar, Chile, Sept. 5, 1919, 4;  
Papudo, Chile, Sept. 17, 1920, 33; Larrain Alcaldia, Chile,  
Oct. 11, 1919, 104; Zapallar, Chile, Feb. 1, 1920, 311.

*Hypochaeris radicata* L. Panimávida, Chile, Dec. 14, 1919, 229.

469. PUCCINIA TARAXICI (Rebent.) Plowr. Brit. Ured. 186. 1889.

*Puccinia Phaseoli Taraxici* Rebent. Prodr. Fl. Neom. 356.  
1804.

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*Leontodon Taraxacum* L. Puente Alto, near Santiago, Chile,  
Oct. 3, 1919, 85.

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